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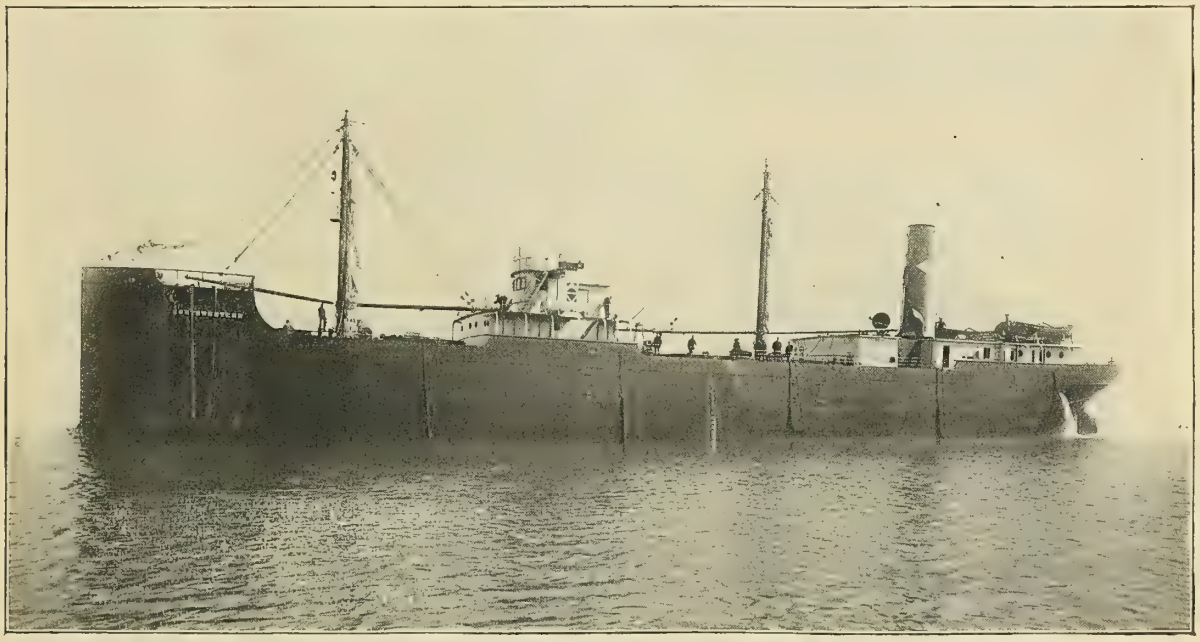
OCEAN-GOING STEAMSHIP NORTHWESTERN, BUILT ON THE GREAT LAKES.

The beginning of this century marks a new departure in the shipbuilding industry of the Great Lakes—the launching of a vessel for salt-water service. The past winter has seen ten such vessels laid down, of which two are ultimately to be assembled and launched in salt water.

Of the remainder, four are being built by the Chicago Shipbuilding Co., for the Northwestern Steamship Co., of Chicago. The present description refers especially to the S.S. *Northwestern*, the first one of this line launched, and resembling in all particulars the others in the fleet.



STEAMSHIP NORTHWESTERN OF THE NORTHWESTERN S.S. CO.

The *Northwestern* is 254 ft. 6 in. long over all, 242 ft. between perpendiculars, with a moulded beam of 42 ft. and 26 ft. 6 in. depth of hull. The stem and sternpost are both of iron, the former 2 3-4 in. by 10 in., and the latter 10 in. by 6 1-2 in. The framing is of 6 in. steel channels spaced 24. in. apart, and additional structural strength is afforded by belt frames of 12 in. channels spaced 8 ft. apart through the length of the ship. The flat keel is of 21 1-2 lb. steel plate, the keelson is of 18 lb., the garboard strakes of 23 lb., and the sheer strakes of 32 1-2 lb. plate. All the hull plating is lap-jointed, the material ranging from 17 1-2 lb. to 22 1-2 lb. plate, according to requirements. There are two principal decks, spar and main, both of steel, and the former having a wood flat in addition. A raised forecastle provides quarters for deck-hands, as well as housing for the windlass engine. Just forward of the engine room and extending part way athwartship is a boiler deck, and bulkheads are carried from it up to the spar-deck, forming the boiler compartment. An inner bottom is worked the full length of the ship, extending out to the turn of the bilge, and as there is very little dead-rise to this form of hull through the middle-body, it affords a 4 ft. water-bottom divided into six compartments. Two athwart-

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ship bulkheads divide the main hold into three compartments, but above the main deck there is no subdivision between the collision bulkhead and the boiler room bulkhead. In the forward deck house are located a chartroom and the quarters of the deck officers and engineers. The captain's room is abaft the wheel house, and beside the bridge on this deck house there is a flying bridge above the wheel house, extending to the ship's side.

Quarters for the quartermaster's and engineers' force are in the after deck house.

There are six main hatches of the following dimensions:

One 16 ft. long, 20 ft. wide.
One 14 ft. long, 20 ft. wide.
Three 8 ft. long, 20 ft. wide.
One 6 ft. long, 18 ft. wide.

All of these extend through both spar and main decks, the former only being provided with coamings. In addition, there are three cargo ports on each side of the main deck.

The *Northwestern* has two pole masts, each carrying cargo booms, the falls being handled by steam winches, while there are independent facilities for handling package freight through the cargo ports. On account of the limited capacity of the Canadian canals, vessels of this type will be obliged to complete their cargoes at Montreal on the outward voyage, and partially discharge there when inbound. On a draught of 20 ft. their displacement is 5,124 tons, and their speed 10 knots, the engines developing about 1,300 I. H. P. at 96 revolutions per minute. The other vessels of the Northwestern Steamship Company's fleet are named, respectively, *Northman*, *Northeastern* and *North Town*.

Steam is supplied by two Scotch boilers, 12 ft. 9 in. diameter, and 11 ft. 6 in. long, fitted with two 46-in. corrugated furnaces. Each has 52 square ft. of grate surface, and 1,784 square ft. of heating surface, and the working pressure is 175 lb. per gauge.

The main engine is of the three crank, vertical, inverted, triple-expansion type, with cylinders 20 in., 33 in. and 54 in. by 40 in. stroke, mounted on hollow box columns, the condenser forming part of the back framing. The H. P. cylinder is fitted with a piston valve, and both I. P. and L. P. cylinders with slide valves, all the valve motions being controlled by Stephenson links: Piston rods and valve rods are of steel, cylinders and pistons of cast iron, and connecting rods of wrought iron. The cut-off in the different cylinders can be adjusted separately to equalize the work done in each, by means of the usual screw and sliding block at the rock-shaft end of the suspension links, moving in a slot in the rock-shaft arm.

The reversing engine is of the direct-acting steam type, the movement of the starting valve being modified by a floating lever attachment from the rock-shaft in such a way as to hold the links in any position to which they may be thrown. The main engine crossheads are of cast steel, with brass shoes. The crank shaft, in one piece, is 11 in. diameter, and the crank pins are 11 in. by 11 in. On the after web of the L. P. crank is a counter balance as shown in the photograph. The thrust shaft, just abaft the engine, is 11 in. diameter, except between the collars, where it is increased to 11 1-2 in., and the diameter of the collars is 18 1-2 in.

The engine being well aft, the propeller shaft is coupled to the thrust shaft, line shafting being unnecessary. The thrust bearing is of the horseshoe type, with separate adjustment for each of the five thrust shoes. The four-bladed propeller, of the built-up type, is 12 ft. 6 in. diameter, and 14 ft. 6 in. pitch, both hub and blades being of cast iron.

The air pump, 20 in. diameter and 14 in. stroke, is worked by a double beam and connecting links from the I. P. cross-head. From the air-pump cross-head, directly connected, are worked a bilge pump on the forward side, and a water-service pump on the after side. The fore-and-aft condenser at the back of the engine has a cooling surface of 1,563 square ft. afforded by 613 tubes, circulating water for it being furnished by a centrifugal pump of 9 in. suction and 8 in. discharge, direct driven by a 7 in. by 7 in. simple engine.

Both main and auxiliary feed pumps are fitted, taking suction from a filter supplied with condensed water from the air-pump discharge. The main feed pump is a compound having steam cylinders 6 in. and 10 in. diameter, and a water cylinder 4 in. diameter, all having a common stroke of 10 in. The auxiliary pump has a steam cylinder of 8 in. diameter, water cylinder of 4 in. diameter, with stroke of 10 in.

There is a "Globe" type stearing engine, 7 in. by 6 in., and two capstan engines, the forward one working the anchor windlass or a capstan at will, and the after one working a warping capstan on the after deck. The forward capstan engine is 10 in. by 10 in., and the after one 6 in. by 8 in.

In addition to the steam steering gear, there is a large hand wheel on deck above the rudder head, which may be thrown into gear for use in case of necessity.

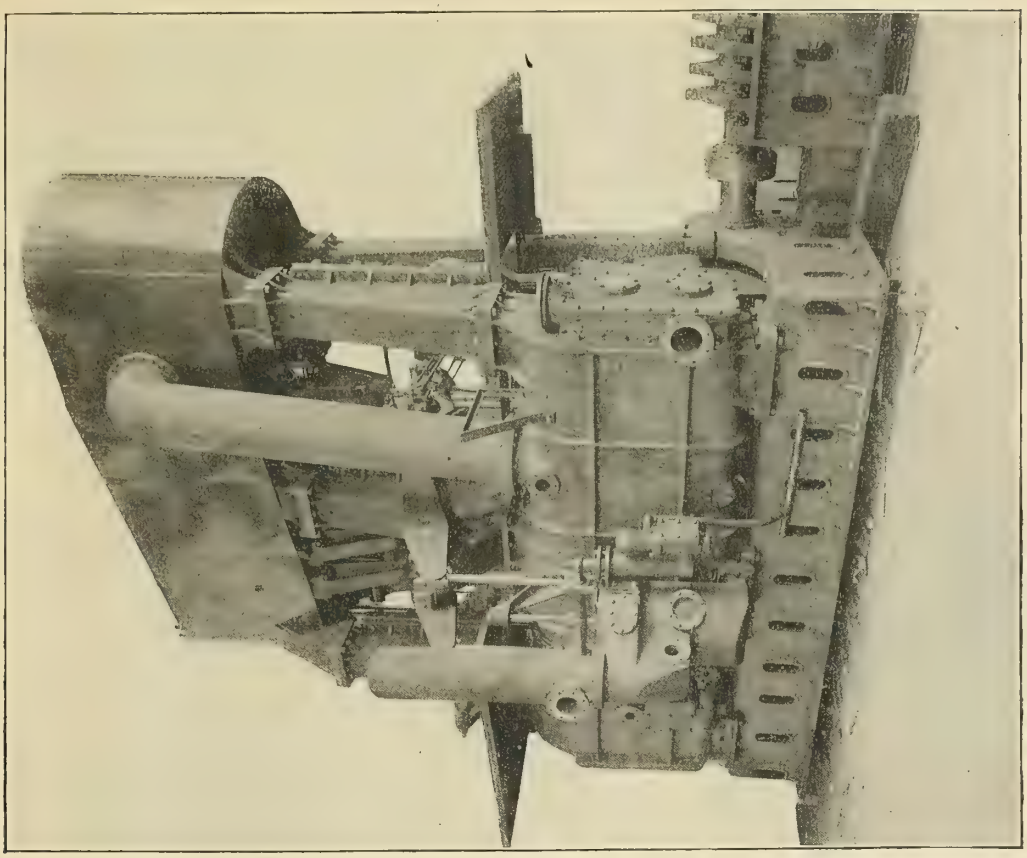
In the engine room there is a ballast pump with cylinders 12 in. and 16. in. diameter and 18 in. stroke. Cargo is hoisted out on the spar deck by steam hoisting drums driven by 7 in. by 8 in. engines, the drums being fitted with brake appliances for lowering. Forward on the starboard side of the main deck is a 12 in. by 12 in. engine, driving a fore-and-aft shaft with universal couplings, which, in turn, controls eleven drums for handling freight through the main deck cargo ports.

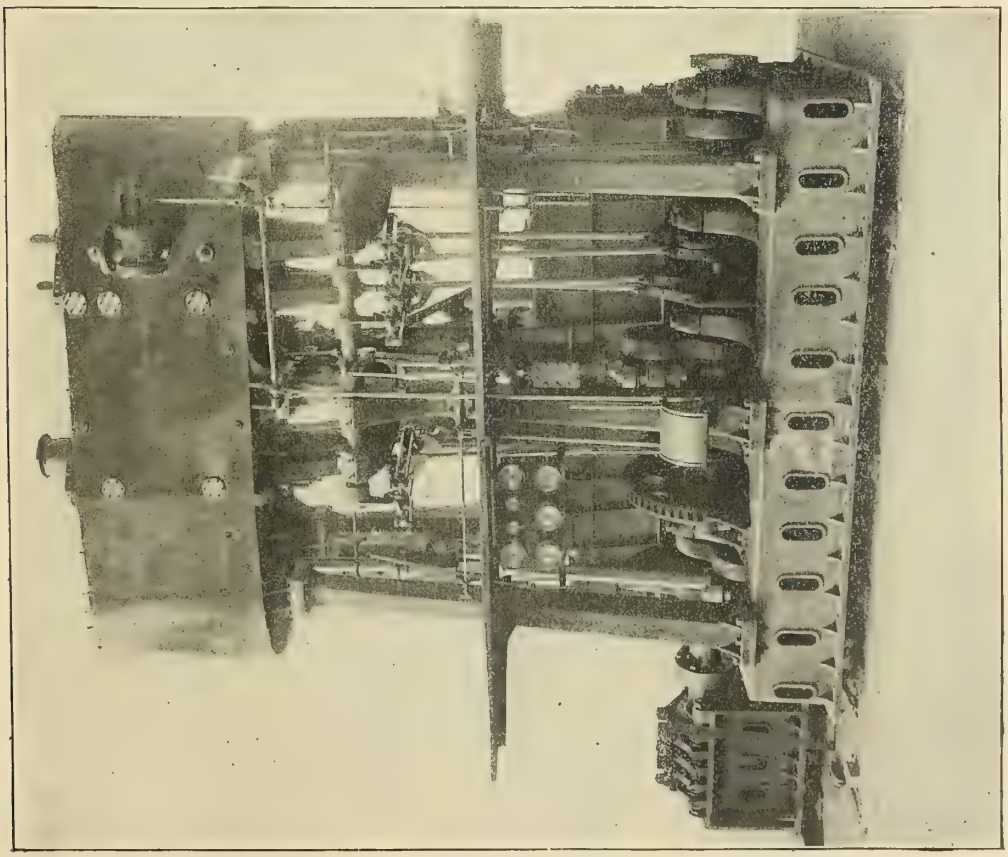
There are 150 incandescent lights on the ship's circuits, current being supplied by a General Electric Co.'s 7 Kilowatt 4 pole generator, direct driven by a 5 in. by 4 1-2 in. engine, running at 550 revolutions.

All castings, shapes and plates used in the construction of the *Northwestern* were furnished by local producers, so this vessel and her sister ships will represent a peculiarly Chicagoan product.

STEAMSHIP ZEELAND.—The latest addition to the Red Star Line, the *Zeeland*, arrived in port at New York on April 23, on her maiden voyage from Antwerp. She is a sister ship of the *Vaderland*.

The American liner *St. Paul*, which has been undergoing repairs for some time past at the Newport News shipyard and later at the dry dock of the Brooklyn Navy Yard, was successfully floated on April 23.



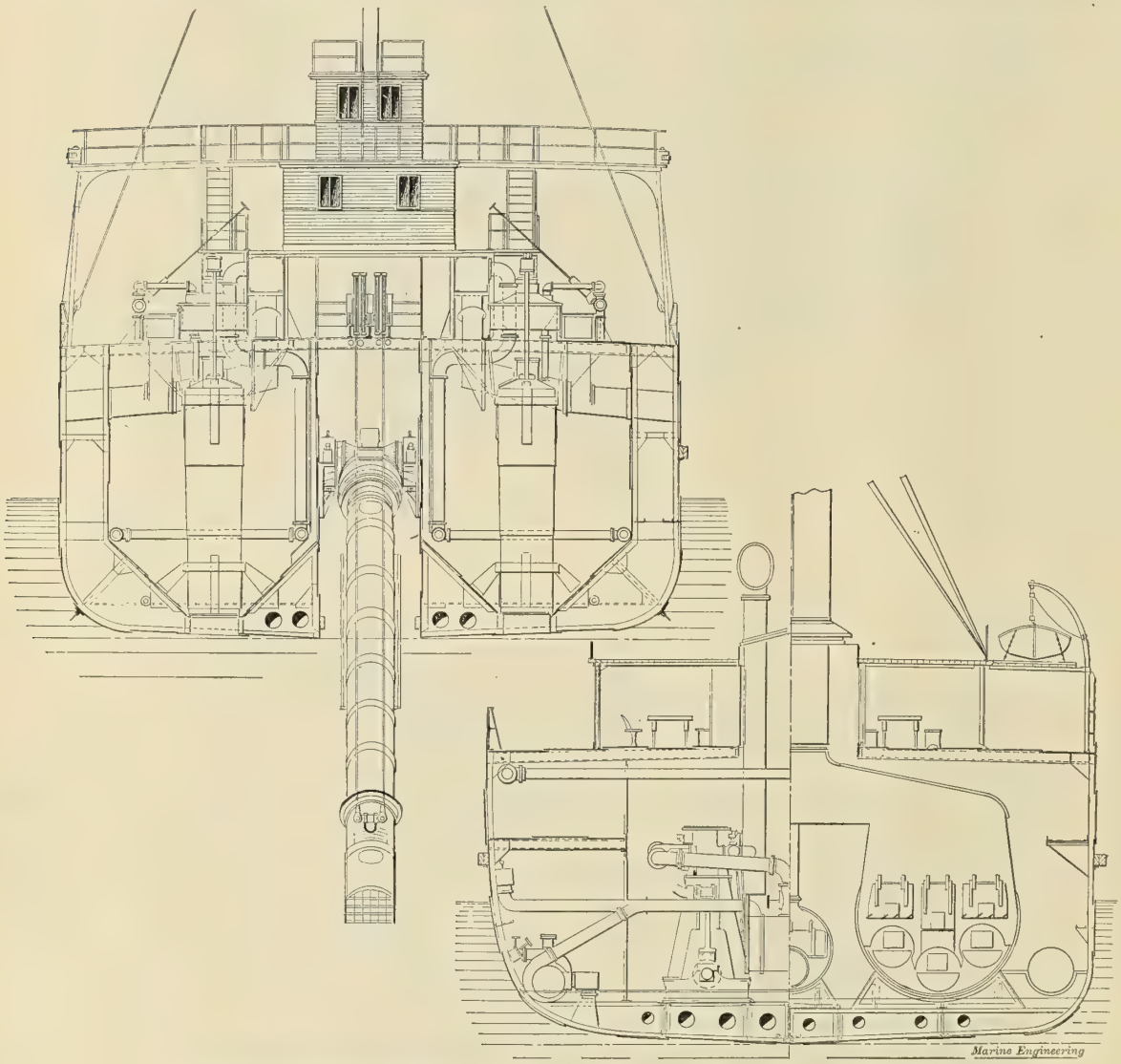


FRONT AND BACK VIEWS OF THE STEAMSHIP NORTHWESTERN'S ENGINES.

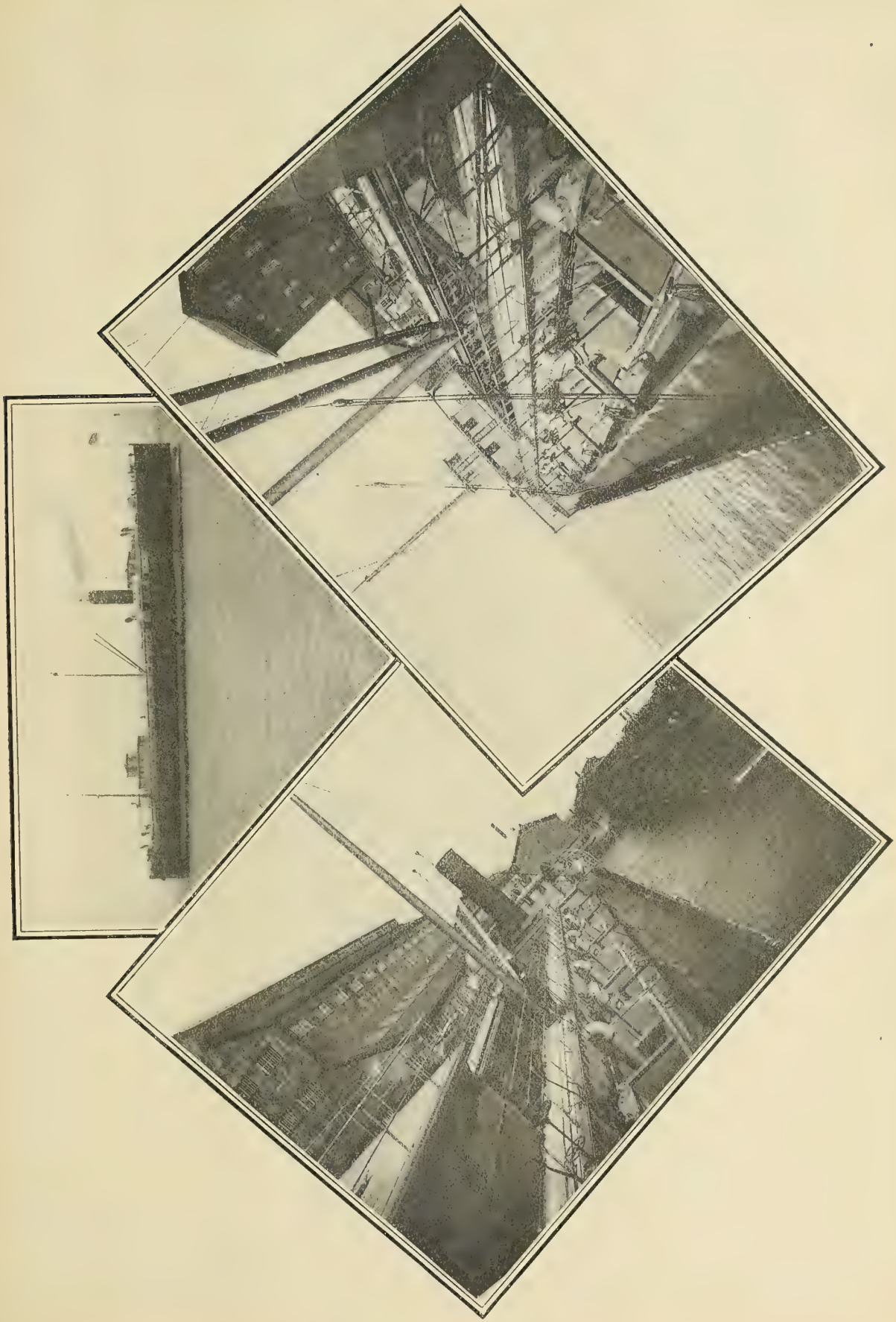
HYDRAULIC HOPPER DREDGES FOR HARBOR IMPROVEMENT WORK AT NEW YORK.

As a further step in the preparatory work for the improvement of the harbor of New York there was launched at the Sparrow's Point, Md., Shipyard, December 20, last, a large hydraulic dredge built to the order of the contractor, Andrew Onderdonk. The contract for the work made by the United States is authorized by Act of Congress, dated March 3, 1898, which provides for the improvement of the harbor of New York by a deep channel 2,000 ft. wide and 40 ft. deep from the Narrows by the "East Channel" across Sandy Hook bar to the open sea. The work, which will be carried out under the direction of the U. S. Army Engineer Corps, will necessitate the excavation of about 40,000,000 cu. yds. of material (sand and silt) from the bed of the channel, and its removal to a dumping ground in deep water, the average distance being about eight miles. In order to carry out this contract Mr. Onderdonk associated with himself D. O. Mills, and General Samuel Thomas, capitalists of New York, and organized the Metropolitan Dredging Co. As a preliminary step in the carrying out of this work the company decided to build two large hydraulic dredges, and placed an order for their construction with the Maryland Steel Co. These dredges are named the *Thomas* and the *Mills*, and it was the latter which was sent into the water at the Sparrow's Point yard on the date mentioned.

In deciding upon the particular type of dredge to be employed, advantage was taken of the experience gained with similar work in the Mersey harbor improvement, and as a foundation for the new designs the plans of the Livepool dredges *Brancker* and *Crow* were adopted. Many modifications, both in dimensions, construction and equipment, were, of course, introduced, and as a result it is estimated that the new vessels will carry 45 per cent more material in the hoppers than the Liverpool dredges, and will load in about 60 minutes. The new boats have more beam and depth and less length than the Liverpool



SECTION THROUGH THE HOPPERS. SECTIONS THROUGH ENGINE AND BOILER ROOMS.



VIEWS OF THE HOPPER DREDGE MILLS OF THE METROPOLITAN DREDGING CO.

dredges, and they attain a speed of ten knots when in regular service. As the *Thomas* and *Mills* are alike the description of one will apply to both.

The *Thomas* is of these dimensions: Length, 300 ft.; beam, 52 ft. 6 in.; depth, moulded, 25 ft.; load displacement, about 7,500 tons. In the construction the vessel is the same depth throughout—there is no sheer—though to avoid the appearance of being hogged the plating is given about 18 in. of sheer at the ends. She has two pole masts, the foremast fitted with one boom, and the mainmast with two booms, and a single straight smoke pipe.

The hoppers for the dredged material extend 125 ft. in the middle of the ship. There are six hoppers on each side of the suction well; four being 20 ft. long by 18 ft. wide, and two 22 ft. 6 in. long by 18 ft. wide. The total capacity of the hoppers is 2,900 cu. yd. of sand.

Forward of the hoppers and extending the full width of the ship and for 50 ft. fore and aft is the dredging machinery space. A 48 in. centrifugal pump is located in the center, with side pipes to the suction and arranged to discharge into two distributing pipes. This pump is driven by two horizontal tandem compound condensing engines, with cylinders 17 in. and 30 in. dia. with 36 in. stroke. The pump is guaranteed to throw 75,000 gallons per minute and be capable of overcoming a resistance equal to about 40 ft. head. Forward of this pump is a large compound condensing pump of the Stilwell-Bierce duplex type, of which the steam cylinders are 18 in. and 30 in. dia. and the water cylinders 24 in. dia., with a stroke of 24 in. This pump actuates the hydraulic jets in the suction drag and in the discharge valves of the hoppers. A hydraulic duplex pump with water plungers 6 in. dia. by 18 in. stroke, capable of pumping against 1,000 lb. pressure, is used for operating the hydraulic cylinders of the discharge valves and also the hoist for the suction pipe.

Aft of the hoppers is the boiler room. The boilers are 14 ft. dia. by 11 ft. 10 in. long, built for a working pressure of 180 lb. They are worked with Ellis & Eaves induced draft. A small donkey boiler 7 ft. 6 in. dia. by 9 ft. long is placed between the main boilers.

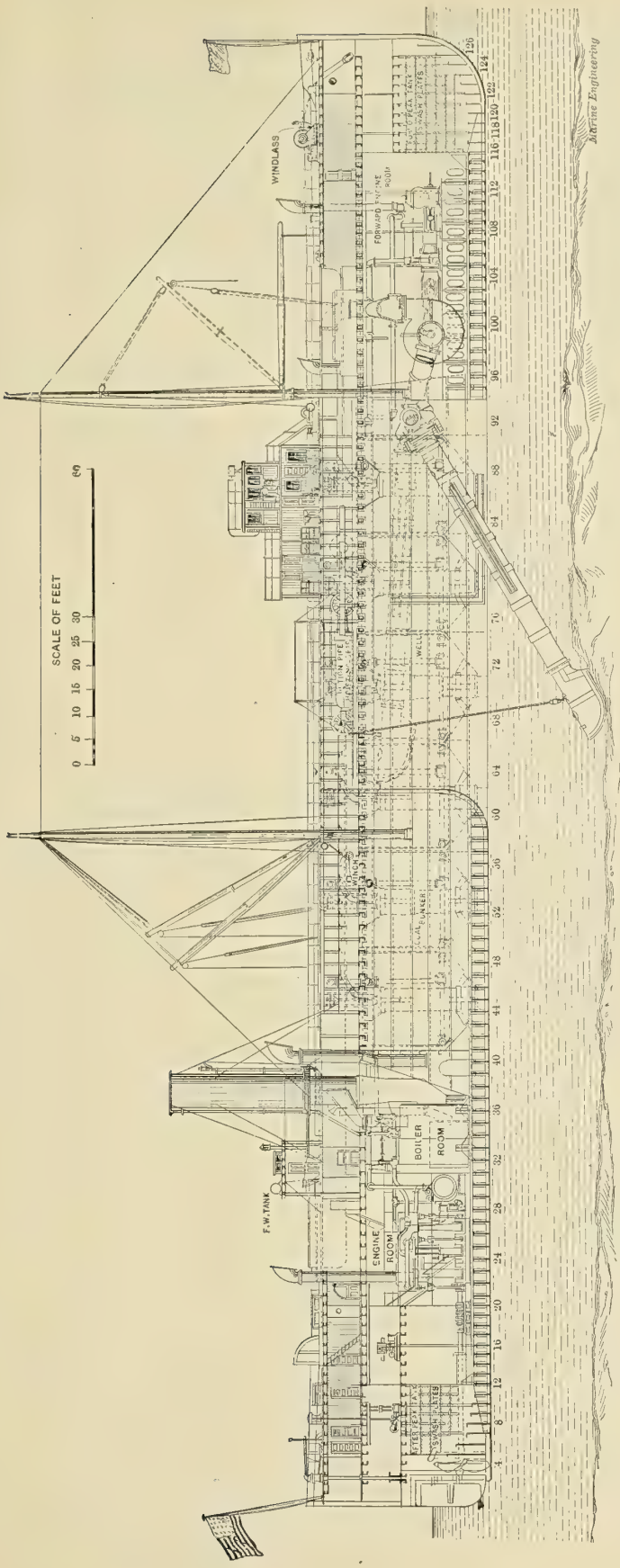
Aft of the boilers are the two propelling engines, driving twin screws. The engines are of the inverted direct acting triple expansion type, with cylinders 18 in., 28 in. and 45 in. dia. and 30 in. stroke. In each engine high and intermediate cylinders are provided with piston valves and the low pressure with a slide valve. The engines are built with cast iron columns, front and back, and the condenser is independent, with detached vacuum and circulating pump. An electric lighting plant and evaporator and distiller are also supplied.

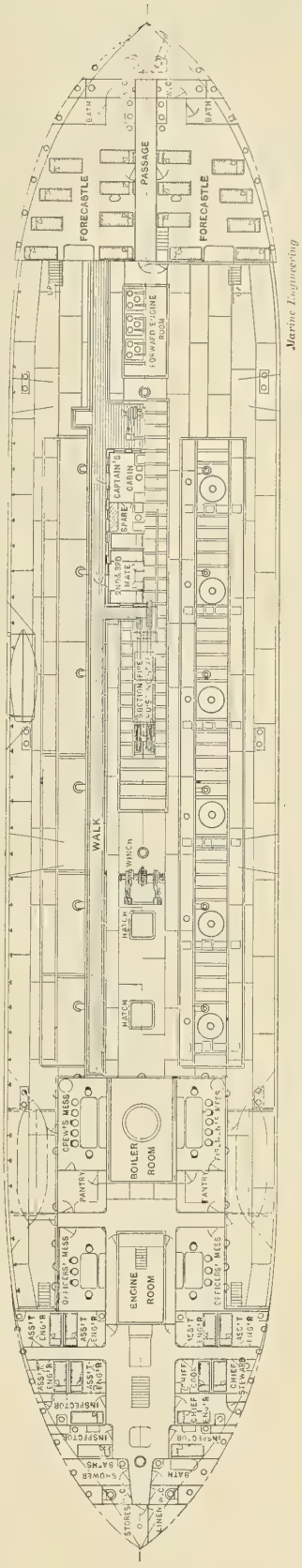
The operation of the dredge is as follows: After lowering the suction tube into the water and exhausting the air from the 48 in. centrifugal pump and connections by the 4 in. air injector the pump is charged and ready to start. After starting, the pump is run until the hoppers are filled with water and overflowing the expansion tanks. During this time the suction pipe is lowered until it is about 10 ft. below the bottom; the dredged material being taken by the suction as fast as it is lowered into the sand. After the suction is lowered sufficiently deep into the material the boat is moved forward at the rate of 25 or 30 ft. per minute, thereby giving the suction end all the material that it can raise and deliver into the hoppers. When the hoppers are filled with material the suction pipe is raised and the pump stopped, and the dredge proceeds to sea. When near the dumping grounds the large compound pumps are started, supplying water to the jets in the discharge valves, thereby loosening up the sand in the hoppers and freeing the valves from the packed sand so that they can be more easily raised. When ready to dump, the pressure from the hydraulic pump is turned on to the 12 in. hydraulic cylinders, one of which is located over the center of each hopper. These cylinders are connected by side rods to the large trunk valves 5 ft. dia. by 21 ft. long, extending through the sand to a seat at the bottom of the inclined hopper outlets, thereby raising the valves about 3 ft., allowing the sand to be dropped through the discharge ports into the sea. While the valves are being raised the jets referred to are acting upon the sand with a pressure of 60 lb. per sq. in., greatly facilitating the discharge of the dredged material. As soon as the valves are opened the suction pipe is lowered into the water, the 48 in. centrifugal pump is started, and the volume of clear water is pumped through the distributing pipes and through outlets into the flushing pipes, which are located at the top of the inclined bottoms of the hoppers. These flushing pipes are provided with perforations for jets for water to flow out, greatly increasing the discharge of material and washing the hoppers clean before closing the valves.

The trunk valves and the expansion tanks employed are in accordance with the patents of Chief Engineer Anthony G. Lyster, of Liverpool, whose experience with the Mersey River improvement work was sought in consultation before the plans of the *Mills* and *Thomas* were drawn.

Accommodations for the crew of the *Thomas* are under the forecastle deck, and are of the most comfortable character. The quarters are fitted with iron bedsteads, and on each side at the forward end there is a large room with three shower baths. Under the poop are accommodations for the engineers, Government inspectors, cook and steward, each being provided with a large room. At the after end are the toilet rooms, provided with showers, tubs and closets. Alongside the engine and boiler inclosures in the house are provided officers' and crew's messrooms and two pantries with lifts to the galley above. The captain has a large cabin and stateroom on the level of the walk over the landers. In the same house are quarters for the first, second and third mates and one spare stateroom. On top of this house is the pilot house, with flying bridge extending to the side of the ship.

The launches of the *Thomas* and *Mills* were carried out very successfully and were attended by a number of invited guests of the shipyard and the contractor. Many of these were from New York, Philadelphia, Baltimore and Washington, special trains for their use having been provided, and they were entertained on their arrival at the shipyard with great hospitality.





INBOARD PROFILE AND DECK PLAN OF HYDRAULIC HOPPER DREDGES MILLS AND THOMAS.

STABILITY OF PASSENGER STEAMERS AFTER COLLISION AT SEA, WITH DISCUSSION OF MEANS TO PREVENT CAPSIZING.*

BY M. BERTIN.

The designs of vessels with cellular belt, of which the first appeared in the spring of 1870, have many times led me to consider the effects of the partial invasion by water upon the stability of ships. The delicate nature of the results, however, and the small theoretical importance of my methods of work have kept me from publishing anything on this subject, except a single paper, after a visit to the Universal Exposition of Chicago, which gave me the occasion to study the rapid revival of naval construction in the United States. My friends of the Navy Department, who opened their archives to me with the greatest liberality, have only received in return this short account of the study of stability after damage, by the aid of sectional models, which appeared in Vol. II of the Transactions of the *Society of Naval Architects and Marine Engineers*. The very simple mode of investigation described in this account is that which has served in all my later researches, with the correction of a slight error in one of the curves, and some improvements due to the expert practitioner who at the same time makes my models and executes the trials of stability.

War vessels alone were employed in 1890-1891, in the experiments at Toulon, which our excellent American colleagues had vaguely heard of during their visit in France. My researches, inspired by the demands of the service, aimed for the improvement of the fighting qualities of the fleet; but general considerations of humanity also presented themselves, for it would be pure barbarism, the danger of capsizing being known, to accept as inevitable for ourselves, or even to wish to a loyal adversary, the fate of the crew of the *Victoria*. If, in the presence of such dangers, resulting from the opening of a breach in the skin of a passenger steamer, the application of the same method of measuring stability leads for the merchant marine, to remedies of equal usefulness, the perfecting of the art of war will have once more aided industrial progress.

For mercantile ships, the study of stability after damage interests especially an International Congress like ours, devoted by its nature to the works of peace. In the case of naval construction, each nation must be guided chiefly by its own circumstances and by its own policy regarding the conduct of naval warfare. In favor of the crews fatally exposed to the perils of war, we could scarcely form more than some platonic wish; that, for example, of seeing all the belligerents accept with unanimous accord, the extension of the convention at Geneva to the varied circumstances of naval battles. The right of passengers on mercantile ships to a more complete security calls on the contrary, without any restriction, for our most earnest solicitude. The International Congress of Naval Architects would not leave its legitimate domain in formulating a desire for the general adoption of measures suitable to decrease the growing perils of navigation on the most frequented routes, and the example given by the principal constructors present would suffice to assure the realization of this desire.

II.

Any vessel seriously damaged, in consequence of a collision or of any other accident at sea, is in danger of sinking in three different ways:

1st. It may, in principle at least, sink without change of trim, under the action of the weight of water which invades it, added to its own weight.

This kind of catastrophe would result if the water could fill the ship uniformly over its length and breadth. It is not likely to occur in fact, however, because the conditions necessary to allow sinking without change of trim are not usually realized.

2d. It may founder by the bow or stern, under the action of the weight of water accumulated at one of its extremities.

Before the adoption of transverse water tight bulkheads, water flowing freely toward the stern by reason of the difference in the initial draught of water, accumulated there until the stern being covered by the sea, the longitudinal stability disappeared; thus, I have seen the *Alabama* founder off Querqueville. The present practice of fitting transverse bulkheads in steel ships, in spite of the insufficient study given to it, suffices to entirely prevent this kind of catastrophe.

3d. It may capsize transversely, in consequence of the rapid diminution of stability which results from the invasion of water in a large mass, and especially from the perforation of the exterior shell which modifies the form of the load water line. All the stability depends, in fact, on those parts of the hull near the water line; as soon as the sea enters freely on the one side and flows out on the other, capsizing is inevitable.

Such is the manner in which to-day the catastrophe of foundering usually results.

This summary analysis of the different methods of shipwreck is not new, for from 1872-73, I have recognized, in the case of a protected cruiser exposed to the fire of artillery, that, in spite of the care given to the bulkheading of the cellular belt, the danger of capsizing transversely always surpasses that of foundering by the head or stern, and, in still stronger degree, that of sinking without change of trim.

The damage to which a steamer is most commonly exposed consists of a single breach, in general of great height, extending at the same time over the hold and over the between decks above the water line. The simple rupture of the skin of the ship in consequence of running upon a reef or of the rupture of a part of the engines, may, however, have as grave effects as the shock of the stem of a colliding ship, because the hold and the between decks communicate together by hatchways with low coamings, rarely isolated by water tight covers, and a breach, whatever it may be, opens then to the sea the whole of a large transverse compartment.

It may happen that a steamer without being riddled with holes like a warship after a fight, may have its hull opened at several points and extending over several compartments by the successive shocks of the colliding ship. The secondary openings thus produced after the principal breach, are limited, for the most part, to the region above the water line.

Whether in the case of a single injury, or in that of

*A paper read at the Congress of Naval Architects, Paris, 1900.

many, allowance must also be made for negligence in closing water tight doors, especially for bulkheads which traverse the passenger decks.

Finally, it is necessary to take into account the fact that steamers navigate under variable conditions of lading, whence result very different conditions of stability. It is in consequence necessary to embrace, in a study of the dangers of capsizing, three conditions: Full load, half load and light condition.

The moderately complete determination of the disastrous consequences of collision and the research for means of preventing them, without being as difficult as the study of the protection of warships, is not, as may be seen, without a certain complication, even when the study is limited to a single ship chosen as a model.

The steamer taken as a type for the present study is a passenger boat 492 ft. in length, and of 10,000 tons displacement at full load.

Such a ship is of the type most frequently met with. It gives well enough the mean between ships of 5,000 to 10,000 tons used for the most part on long voyages, and those of 10,000 to 20,000 tons of the large transatlantic lines.

The data adopted for the initial stability in the intact condition, in the three conditions of lading, are as follows:

The experiments were not able to reach the angle of capsizing; towards the inclination of 80 deg. the results obtained are already a little uncertain, but this is unimportant. The figures of Table II prove clearly that the stability of the ship intact is well assured in all conditions of lading, and that the center of gravity could even, without any danger of capsizing, be situated higher than it has been supposed. These results are in accord with the facts of experience. There have been, in fact, examples of passenger steamers sailing in all security with initial metacentric altitudes $\rho_0 - a$ less than .98 ft. to .49 ft. or even with small negative values. In this latter case, in the place of one position of upright equilibrium, there are two, one each on the port and starboard, making a small angle i with the upright position.

Very small or negative initial metacentric heights become dangerous only in case of damage to the ship.

III.

Let us suppose now that a breach opens to the sea one of the compartments comprised between two transverse bulkheads; that, for example, whose section is represented in Fig. 1, and which contains a group of boilers. The length of this compartment is 51.16 ft. The invasion of water in the hold and the two between decks will produce the three following effects:

TABLE I.

	Full load.	Half load.	Light.
P. Displacement	10,000 tons.	8,750 tons.	7,500 tons.
ρ_0. Initial metacentric radius	9.84 ft.	10.98 ft.	12.40 ft.
a. Distance from the center of G to the center of K	6.89 ft.	9.02 ft.	11.41 ft.
$\rho_0 - a$. Initial metacentric height	2.95 ft.	1.97 ft.	.98 ft.

The three preceding metacentric heights have been chosen by considering that, on passenger steamers in general, the extreme limits of $\rho - a$ are about 3.44 and .49, and, that on the other hand, on the same ship, the value of $\rho - a$ varies at the most in the ratio of three to one, when it passes from full load to the light condition.

The metacentric heights $\rho - a$ corresponding to the angles of inclination θ, in all the tables which follow, with the exception indicated, are counted above the center of gravity G, on the axis GK, which joins this center to the center of buoyancy K of the vessel in equilibrium; the value of ρ is then measured from the fixed point K to the variable metacenter M situated on the axis GK which corresponds to each particular water line.

In the initial condition of Table I and with a hull presenting the usual transverse form of passenger steamers, Figs. 1 and 3, the inclining experiment under large angles, made on a model one-hundredth scale, leads to the following results:

1st. A flooding of the bilges, added to a lowering of the center of gravity, with modification of the curve of stability under finite angles of inclination which correspond to the new draught of water.

The water entirely fills the central compartment A, with a capacity estimated at 38,820 cu. ft., with the exception of the volume occupied by the boilers, estimated at 14,820 cu. ft., thus giving as the difference 24,000 cu. ft. It fills equally the two coal bunkers B, B', of which we suppose the doors open, with the exception of the volume occupied by coal. We will consider the bunkers as full of coal in the case of full load, three-fourths full in the case of half load, and half full in the case of light condition; we will suppose, further, that the water introduced into the interstices of the coal fills a third of the entire volume.

2d. In the second between deck C. where there are the same transverse bulkheads as in the hold, small invasion of water with a diminution of the value of initial ρ, and all the values of ρ corresponding to the different inclinations.

TABLE II.

	Full load.	Half load.	Light.
$(\rho_m - a) \sin \theta_m$. Maximum stability arm	4.49	3.71	2.07
θ_m. Inclination corresponding to this maximum	80°	80°	55° and 90°
θ. Angle of vanishing statical stability		Well beyond 90°	
ϕ. Angle of dynamic stability		A little beyond 40°	

We will suppose the invasion limited to the same transverse bulkheads as in the hold, the water tight doors being closed. We will neglect the volume occupied by the objects contained in the compartment *C*, which is generally set aside for the accommodation of third class passengers.

3d. In the first between deck *E* and the deck houses, no invasion of water, nor changing of the initial metacentric height, but a very large diminution of the values of ρ corresponding to large inclinations.

These compartments where there is no water tight bulkhead, except sometimes at the front end, are open freely to the sea from one end of the ship to the other when there is a breach, and they no longer contribute to the stability. The part occupied by the objects contained in them is negligible. It will also be impossible to take account of the temporary and ineffective obstacle which state room bulkheads present against the invasion of the water.

The model was arranged in such way as to represent the situation as it has been thus defined. The data concerning the danger of capsizing are found in résumé in Table III, where all the angles are counted from the upright position, for the case of the light condition which gives rise to an initial inclinaton for equilibrium, as well as for the two other conditions of load.

The ship in light condition, and which is in unstable equilibrium in the upright position, finds itself in stable equilibrium under the inclination i of 12 deg., with a metacentric height $\rho_1 - a$ equal to .69 ft. Counting from this position of equilibrium, the inclination θ_m is reduced to 18 deg. and the angle of capsizing θ is only 29 deg.

Except in the case of very bad weather, the ship is not in a very perilous situation, in any of the three conditions of lading of Table III, although the margin of security is small in light condition. Let us remember that this table supposes:

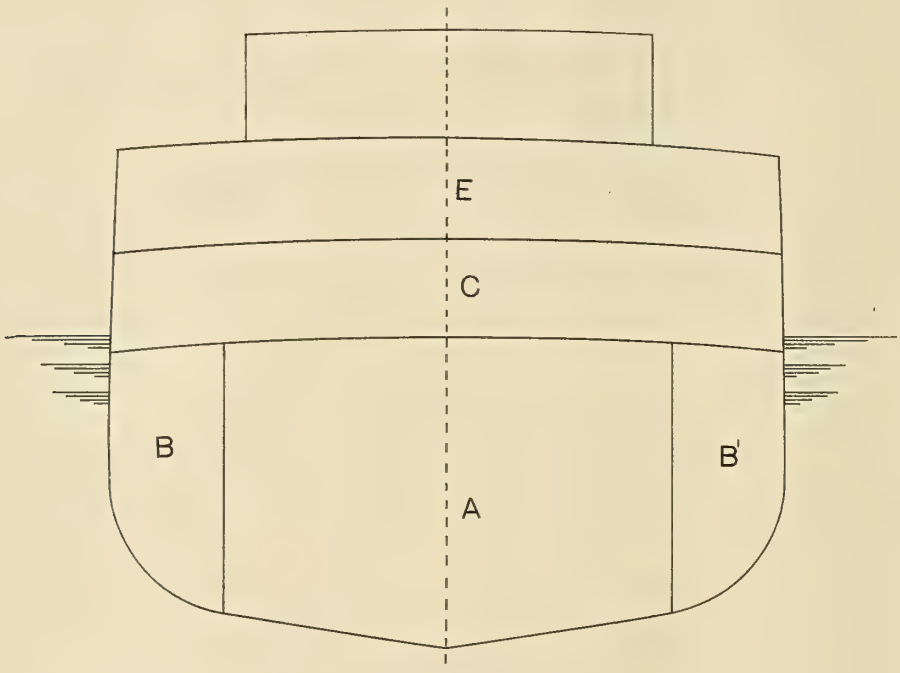


FIG. 1.

The damage limited to a single transverse compartment.

The invasion of water symmetric on the two sides.

The water tight doors of between deck *C* closed.

The last two of these conditions, absolutely indispensable, as we shall see later on, are rarely realized in the midst of the confusion which follows a collision. Few cases can be cited, even of ships with full load and with a large positive initial metacentric height, which do not immediately show an inclination after collision. It has been seen, too often, on the contrary, that the invasion of the water reaches the intact compartments, through the doors of the water tight bulkheads.

TABLE III.

	Full load.	Half load.	Light.
$(\rho_0 - a)$. Initial metacentric height	2.49 ft.	.82 ft.	—.43 ft.
$(\rho_m - a)\ sin\ \theta_m$. Maximum stability arm	.85 ft.	.69 ft.	.46 ft.
θ_m. Inclination corresponding to this maximum	23°	26°	30°
θ. Angle of vanishing statical stability	47°	45°	40½°
ϕ. Angle of dynamic stability	12½°	15½°	11°
Same angle referred to intact ship	12°	14°	12°

Let us seek now the result in Table III, when the water invades only one of the two lateral compartments of the hold *B*, the compartment *B'*, opposite the

The injuries here considered being such as may readily occur, Tables III, IV, V explain well how the guarantees of security assured by the usual subdivision

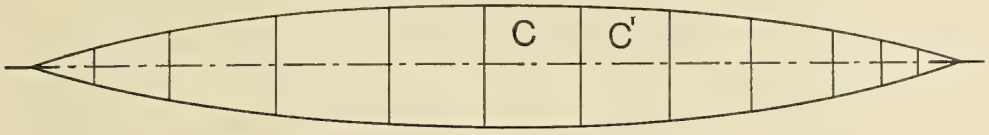


FIG. 2.

breach remaining water tight. There is always then an inclination of equilibrium *i*, from which we will count the further inclinations, as noted above. In Table IV we have in résumé the results which follow from this new set of conditions:

The situation has grown decidedly worse and presents, for the ship in light condition, dangers which

of passenger steamers, are insufficient, as has been unfortunately proven many times over.

It remains to us to search for the means of warding off these dangers, of which we have analyzed the causes, and to study their efficiency.

We set aside, as useless, systems of exterior defenses which may be imagined to protect the hull.

TABLE IV.

	Full load	Half load.	Light.
Initial inclination for equilibrium	3°	8°	17°
Initial metacentric height	2.59 ft.	1.90 ft.	1.77 ft.
Maximum stability arm	.75 ft.	.62 ft.	.43 ft.
Inclination corresponding to this maximum	21°	18°	14°
Angle of vanishing statical stability	43½°	37°	23½°
Angle of dynamic stability	11°	10½°	7½°
Same angle referred to intact ship	10½°	9°	6½°

would be shown furthermore to those on board, by an initial inclination of 17 deg. The stability becomes so feeble, towards 20 deg. of inclination, that the pressure of the wind together with the effect of very moderate waves would suffice to capsize the ship.

It remains simply to add to the effect of the preceding damage, that produced by the opening of a water tight door on the second between deck. We will suppose then that to the compartment *C*, open to the sea in the case of the Tables III and IV, is joined the neighboring compartment *C'*, as is represented in Fig. 2.

In this new situation, the condition of the vessel, with regard to stability and to the danger of capsizing, is indicated by Table V.

This time the situation is plain, at least for the light

Metallic belts of great width furthermore would render impossible, with rolling, the use of small boats which, on the contrary, it is necessary to facilitate as much as possible. We will limit ourselves to the study of a system of interior subdivision which will assure safety without compromising anything, neither the conveniences of accommodation, nor the demands of the service on board, and without imposing serious expense for initial construction.

LLOYDS' REGISTER SHIPBUILDING RETURNS.—The published returns for the quarter ending March 31, 1901, give a total of ships building, exclusive of warships, in the United Kingdom of 444, of 1,303,116 gross tons. The number of merchant ships of over 100 tons building in foreign countries places Germany

TABLE V.

	Full load.	Half load.	Light.
Initial inclination for equilibrium	7½°	14°	25½°
Initial metacentric height	1.54 ft.	1.08 ft.	1.51 ft.
Maximum stability arm	.36 ft.	.20 ft.	.07 ft.
Inclination corresponding to this maximum	13°	10½°	4°
Angle of vanishing statical stability	27°	19½°	7°
Angle of dynamic stability	7°	6°	1½°
Same angle referred to intact ship	6°	4°	1°

condition, even leaving aside all consideration of dynamic stability. A vessel in equilibrium under an inclination of 25 deg., which finds at 7 deg. farther its position of capsizing is a lost vessel, even in a calm sea.

second, with 73 ships, of 232,559 tons; the United States third, with 63 vessels, of 193,033 tons, building on the coast, and France fourth, with 51 vessels, of 134,419 tons.

Stern Wheel Steamer for the Amazon.

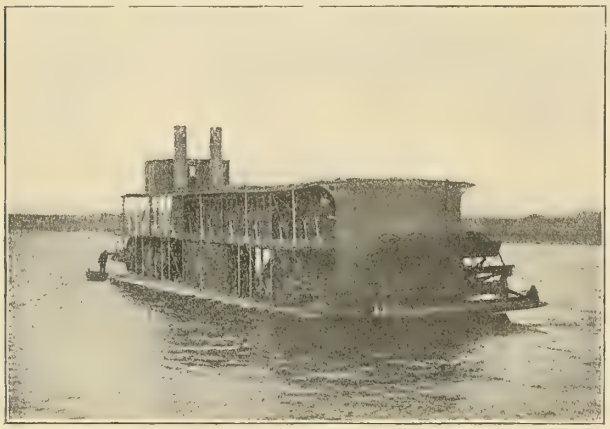
A fast stern wheel steamer was recently completed by Cochran & Co., Limited, Annan, Scotland, for the Bolivian Government. She is 129 ft. over all, 22 ft. beam and 4 ft. deep. The hull is of galvanized iron, built in eight sections for convenient shipping to South America, and is specially strengthened on the bottom to reduce the chance of injury from grounding.

The engines, located at the after end, are of the compound, horizontal surface condensing type, with cylinders 15 in. and 32 in. diameter by 4 ft. stroke. An independent condenser and air pump are placed forward of the main engine.

The two boilers, which are set forward, are of the locomotive type, 4 ft. 8 in. diameter and 13 ft. long. Forced draft is provided by a small fan and steam is supplied at 180 lb. pressure.

The strains on the hull due to the weights at the ends are taken care of by a system of bolts and tie rods.

On the main deck, which is of teak, are two small deckhouses, containing lavatories, shower baths, for the officers and crew, messroom and storeroom.



Hammocks are swung at night in the open space for the crew. Forward are two galleys, one for the crew and one for Europeans. Cold storage is provided in the hold by means of a Linde ammonia compressor placed near the boilers. At the bow is a windlass.

On the upper deck, attached to the sternwall bulkhead, is a small house containing lavatory, shower and pantry. In the large deck cabin amidships there are comfortable accommodations for the commissioner, chief and second engineer and secretary, and also three extra rooms, a library, chronometer room and bathroom. These cabins are finished in mahogany and provided with a system of cool air circulation. The deck space between the two deckhouses is arranged for dining table and seats and a punkah overhead to provide draught.

A sun deck extends over the upper deck and is of the same length. At the forward end is a teakhouse and cabins for captain and two mates. From amidships aft this sun deck is in two thicknesses, with perforated water pipe between for spraying water and thereby cooling the deck and cabins.

On trial over the measured mile this unique steamer made a speed of 12 miles an hour.

Submarine Signaling.

Interesting experiments of a new system of submarine signaling have recently been carried on in Boston Harbor and vicinity under the direction of A. J. Mundy, of the Gray Telephone Co. The system is based upon the principle of the transmission of sound through water. A bell is submerged below the surface of the waters of the bay, and rung by the operator above by means of an electrical mechanism. As each letter of the alphabet is represented by a certain number of tolls, intelligible messages may be sent.

The tests were conducted on board the *Seabell*, a small covered barge specially built for the purpose. In the center of the hull is a well hole through which the bell with ringing device is lowered by a windlass to any desired depth. A small gas engine runs a dynamo for supplying the electric current. On a key board are seven keys connecting the dynamo and commutator for operating the bell. By pressing each key a different number of strokes is given on the bell. After experimenting with several forms of receivers for detecting these submarine sounds, very simple devices have been adopted. A common ear trumpet, the large end sealed with tin and the small end screwed into the end of a piece of gas pipe, when submerged six feet in water, enables the observer to hear at the other end of the pipe, the bell at a distance of three miles. An electrical receiver has been made which will detect the sounds of the bell twelve miles away and convey them to any part of the ship. Dr. Elisha Gray, who invented this system, devised an apparatus attached to the receiver to ring a gong on the ship when the submerged bell rang.

In adapting these inventions to practical use, the bell may be anchored to a buoy at any desired spot and operated by a current passing through a light submarine cable from the shore. The receiver is lowered from the ship under the surface of the water. The simplest means of detecting the bell when not over a mile away is to go down in the hold of the ship and listen for the sounds with the unaided ear. By placing one end of a wooden rod against the skin of the ship, and listening at the other end, the bell can be heard at a distance of three miles.

The most ingenious method for a ship to find her way straight to the channel of a harbor has been worked out by the use of two submerged bells. These are placed at equal distances from and on either side of the channel, and are rung by cable connection at exactly the same moment. The ship feels her way along by using the receiver. One bell is pitched higher than the other, and, assuming that the first lies to the north of the lower pitched bell, if its sound reaches the vessel first the navigator knows he is too far north. He then proceeds south until he reaches a point where the sounds of the two bells are heard simultaneously. This point is on the line, all points of which are equally distant from the two bells, because sound travels at a uniform speed in water as in air, though more rapidly. From this point the navigator learns from his chart the course by compass to the mouth of the harbor, maintaining and verifying it by keeping the sounds of the bells coincident.

For crooked channels a more elaborate system is required and a third bell is used.

EXPLANATION OF A SIMPLE METHOD OF LAYING OUT SHIP VENTILATING COWLS.

BY GEO. C. STANLEY.

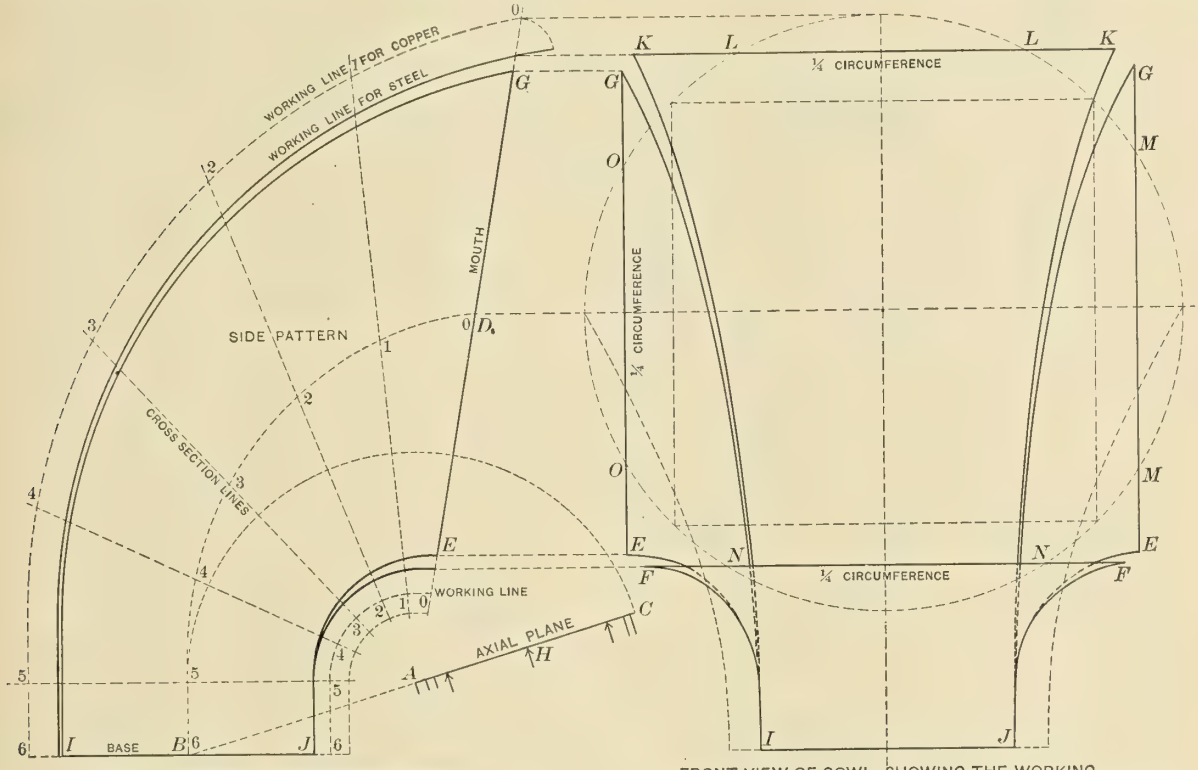
Ventilating cowls on the modern steamship, with their yawning mouths, reared above the surrounding objects, to catch the wind, are very prominent features in deck fittings. And when nicely proportioned and well made, they form a harmonious arrangement of outline, which satisfies the eye of the nautical critic as well as enhances the beauty of the vessel by their graceful curves.

The deck fittings on foreign built vessels, from our point of view, seem to be very crude in their construction and with an excess of material in their make up; more especially in the case of ventilating cowls. In these, the racial traits of each, both in workmanship and design, are clearly defined, and from the prominence of these fittings, the careful observer soon acquires a faculty of identifying the nationality of foreign vessels.

With the exception of ventilating cowls, the general arrangement and finish of deck fittings, on an American built vessel are very pleasing to the eye. In the shape of the cowls, however, there is plenty of room for improvement. It is a common sight on many of our vessels to see a miscellaneous assortment of ventilating cowls, with a combination of every known shape, some having a small diameter of base with a very large flaring mouth, and others with a large diameter of base and a small mouth, with no relative proportion to each other whatever. These features, with the prominence of these objects, mar the beauty of the general arrangement of an otherwise well finished vessel.

In designing a group of cowls for a vessel, the visual effect should be taken into consideration, as well as utility, as it costs no more to make a well shaped cowl than it does to make a poor one.

In the annexed sketches are presented a group of six cowls, and a very simple method of determining their outlines from the diameters of their bases, and the development of the patterns for their construction. In Fig. 3, the group of cowls is shown, ranging from 4 in. to 14 in. dia. of base. It can be readily seen that their curves and diameters have a relative proportion to each other. In Fig. 4 is shown the method of obtaining the outlines from the diameter of the base. The throat line is first determined, its radius being taken as one-fourth the diameter of the base. Thus the cowl in Fig. 4 is 14 in. dia. at base, and the radius of the throat is 3 1-2 in. This is the largest cowl of the group shown in Fig. 3. In developing the further outline draw in the throat and project a line parallel to the base as from *E* to *C*. With *A* as a center, draw an arc tangent to the perpendicular line through the center of the base and cutting the horizontal line at *C*. This point of intersection is the center for the curve of the back or crown. Draw a line from *A* to *C*, which forms the axial plane, upon which will be found the centers of the different radii required in developing the outlines, or the patterns of the sheets to form them. Bisect the axial plane and you obtain the point *H;* this



SIDE VIEW OF COWL, SHOWING THE METHOD OF OBTAINING THE SIDE PATTERNS.

FIG. 1.

FRONT VIEW OF COWL, SHOWING THE WORKING POINTS IN THE PATTERN SHEETS.

FIG. 2.

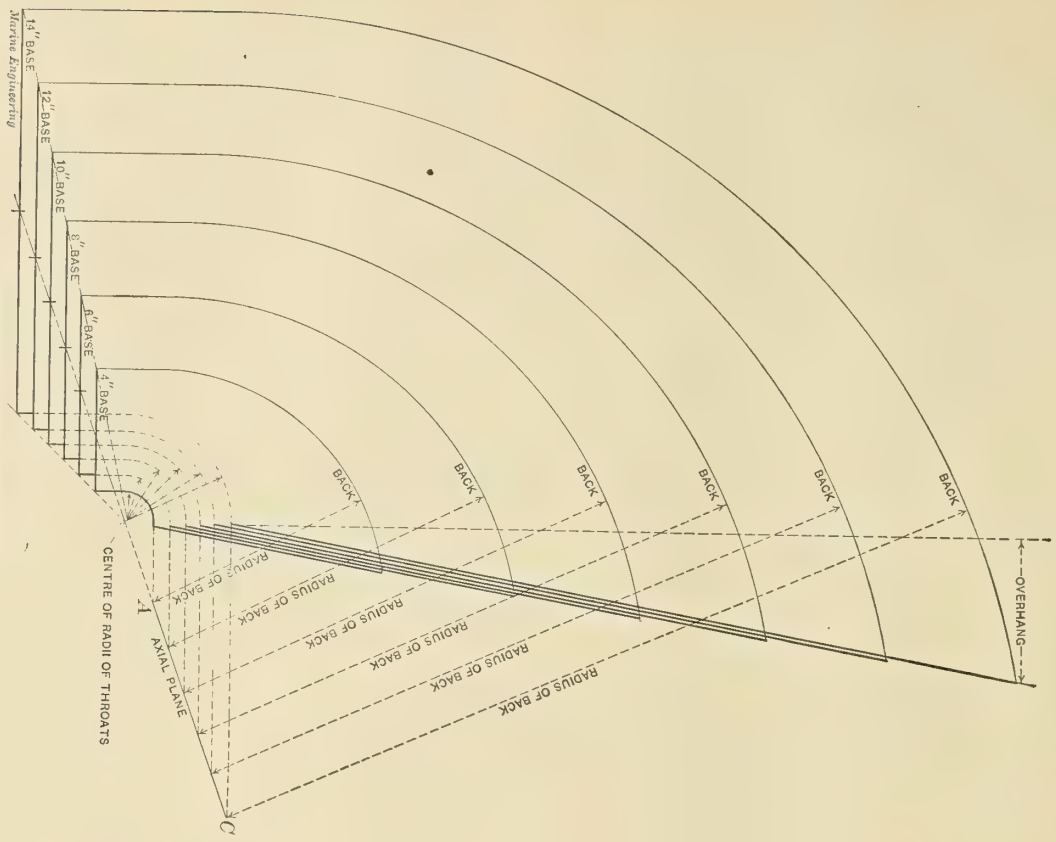


FIG. 3. GROUP OF SIX COWLS.

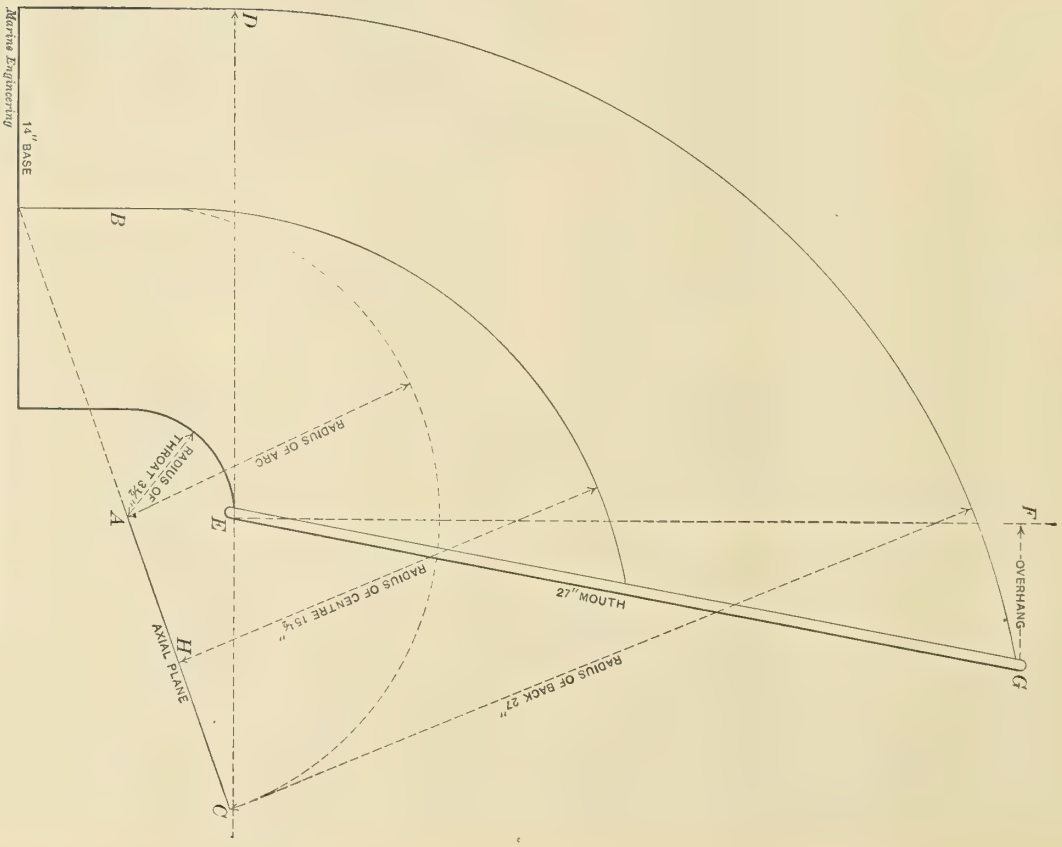


FIG. 4. METHOD FOR DEVELOPING OUTLINES.

is the center of radius for a curve that will pass through the center of the cowl from the base to the mouth. Between the points *H* and *C* the centers for all the curves used above the center line of the cowl will be found, and an equal distance between the points *H* and *A*, will give the centers for a corresponding curve below the center line. Extending the line of the axial

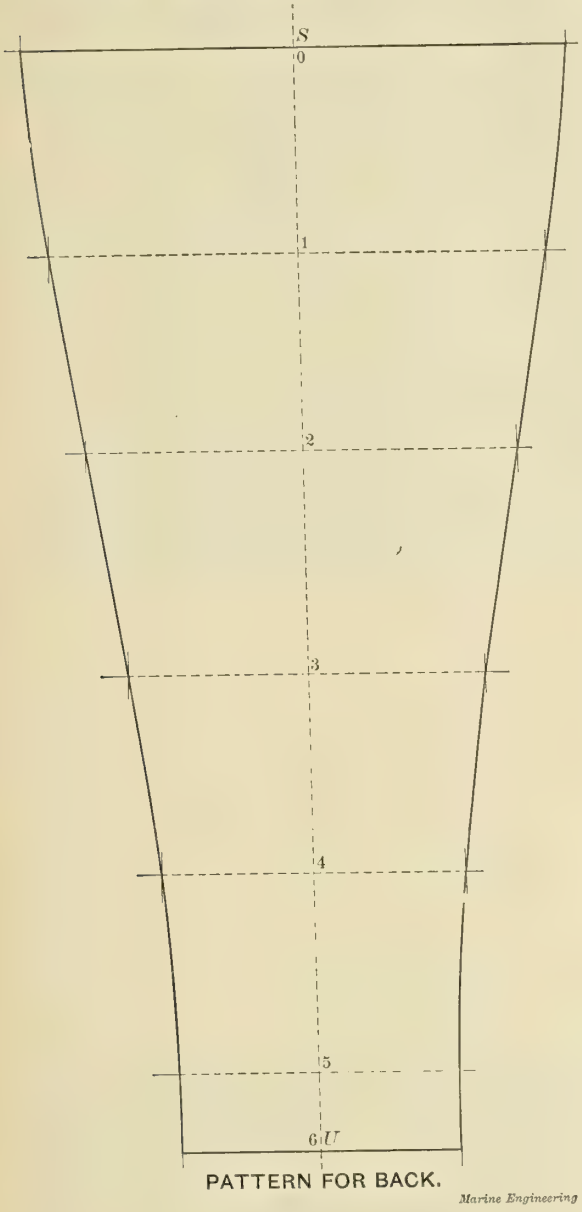


FIG. 5.

plane through the cowl, the points of intersection with the perpendicular line through the center of the base will give the base line of the cowl, with a proportional amount of straight part to receive the usual fittings. In Fig. 3 the line of the axial plane cuts the center of the base of each cowl.

In laying out a group of cowls for a ship, first establish the axial plane from the largest cowl in the series. From this plane the others can be developed, and so they will have a relative proportion. In developing the patterns for an axial seamed cowl, as represented in Figs. 8 and 9, mark off on the base and mouth of the cowl the points *II* and *EG*, Fig. 1, which should equal one-fourth of the circumference of their respective diameters. Draw the curved lines from *E* to *J*, and from *G* to *I;* this gives the pattern for the sides. The center of radius for these curves is found on the axial plane.

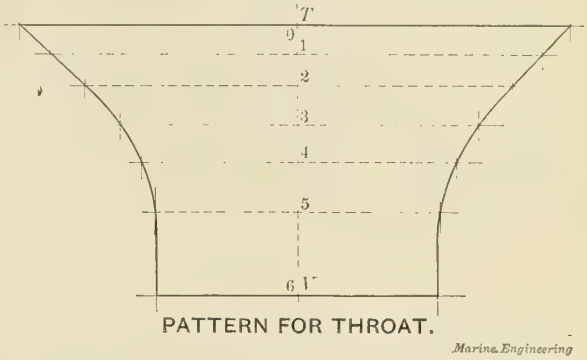


FIG. 6.

To obtain the pattern for the back and throat pieces, divide the center line through the side pattern into any number of equal parts, and from the center of radius of throat, draw the cross sectional lines through the side pattern, which will give one-fourth of the circumference of the cowl at these points. Extend these lines until they cut the curve of the back, and the curved working line at the throat numbered *1, 2, 3, 4* and *5*. Transfer these divisions as they occur to the straight lines *SU* and *TV*, Figs. 5 and 6. Draw lines through these points of divisions at right angles to the lines *SU* and *TV*, and make them correspond to the length of the cross sectional lines in the side pattern. With a light wooden batten sprung along the extremities of these lines, draw the outlines of the patterns for throat and back. In Fig 2, the dotted lines give the front view of the cowl. The solid lines show the edges of the pattern sheets in the flat before being worked into shape, and on the working lines.

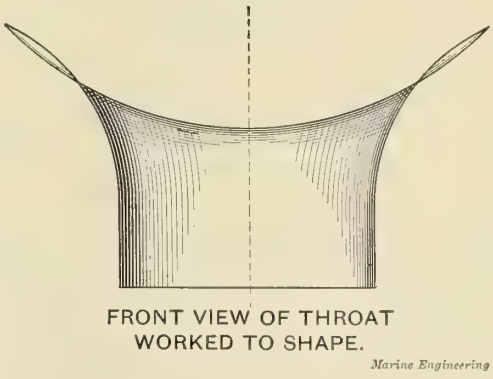
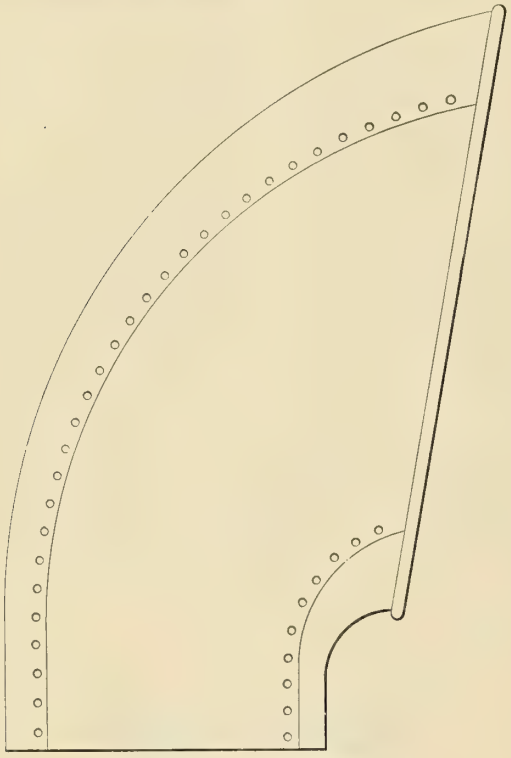


FIG. 7.

In making the cowls of planished iron or steel, the back and side sheet are worked down in the center on a hollow block between the points *LL, MM* and *OO*. In working down the centers, the edges of the sheet will rise to the sweep. The edges of the throat piece are peened to the sweep of the curve, and the center

filled out afterwards. The four pieces are then rounded up and planished on suitable heads, fitted together, riveted, and a finishing bead put on the edge.

Fig. 7 shows the front view of the throat piece worked to shape; this is the most difficult to make, and care is required in its manipulation. In making the cowls of sheet copper, very little work is performed before brazing. The pattern sheets of the throat and back are bent to the working lines as shown in Fig. 3, the edges are worked over about 1 in. to meet the side pattern and then scarfed. The edges of the side patterns are then scarfed and cramps cut to receive the back and throat pieces, as shown in Fig. 9. They are then fitted together and brazed. After the seams are dressed the cowl is then rounded up and planished on suitable mandrels and heads.



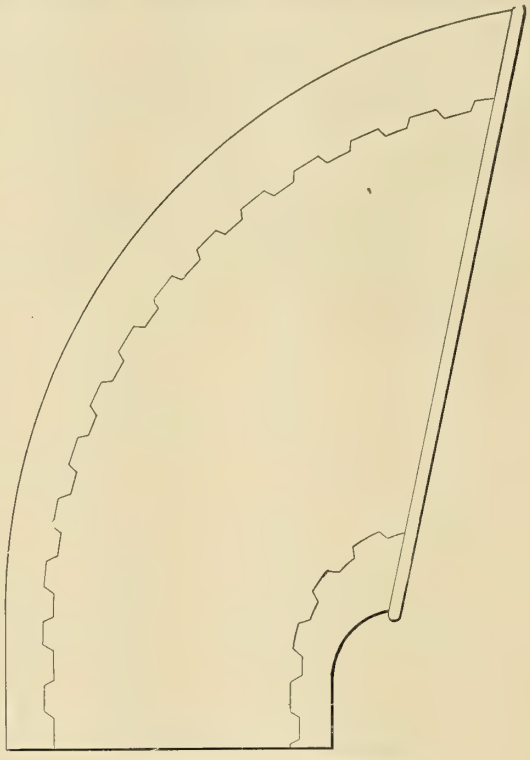
FINISHED COWL IN FOUR PIECES, STEEL.

FIG. 8.

The finishing bead on the edge of the mouth of the cowl is made of a split tube, and is bent to shape around a wooden sweep the radius of the mouth, with a strip of metal in the slit to keep it from closing and also to keep the slit in the center.

This method of making cowls is very flexible. The cowls may be proportioned to suit the judgment of the designer, or the requirements of a case, by simply altering the pitch of the axial plane. The principal features in this method, which will recommend its use, are: The simplicity of development of the outlines and patterns, the absence of cross sectional seams, a uniform thickness of metal throughout the cowl, and the saving of time, labor and material. A cowl made from this method does not look as though it had been constructed from the scrap heap, but gives a finished appearance well worth trying for in an up to date steam vessel.

RAISING A SUBMERGED SHIP.—While the steamer *South Portland* was discharging her cargo of lime at San Francisco, fire broke out and quickly spread through the vessel. Engines were summoned and several streams of water were soon filling the hold. The ship then began to sink at the bow until the forefoot rested on the bottom in 40 ft. of water. Wreckers prevented the stern from sinking, and built two cofferdams about the forward hatches. Then pumps with a capacity of 70 tons a minute began to discharge the water from the vessel. The deck, however, proved too weak to sustain the pressure, and collapsed. Then the cofferdams were replaced by one covering the entire forward part of the deck, 18 ft. high, 54 ft. long and 24 ft. wide. The pumps were again started and in forty minutes the steamer was floated.



FINISHED COWL IN FOUR PIECES, COPPER.

Marine Engineering

FIG. 9.

LEYLAND LINE SOLD.—J. P. Morgan & Co. have secured a controlling interest in the Leyland Line, paying for the common stock at the rate of $71 a share. This stock recently sold for $50 a share. It is probable that this line will be consolidated with the Atlantic Transport Line.

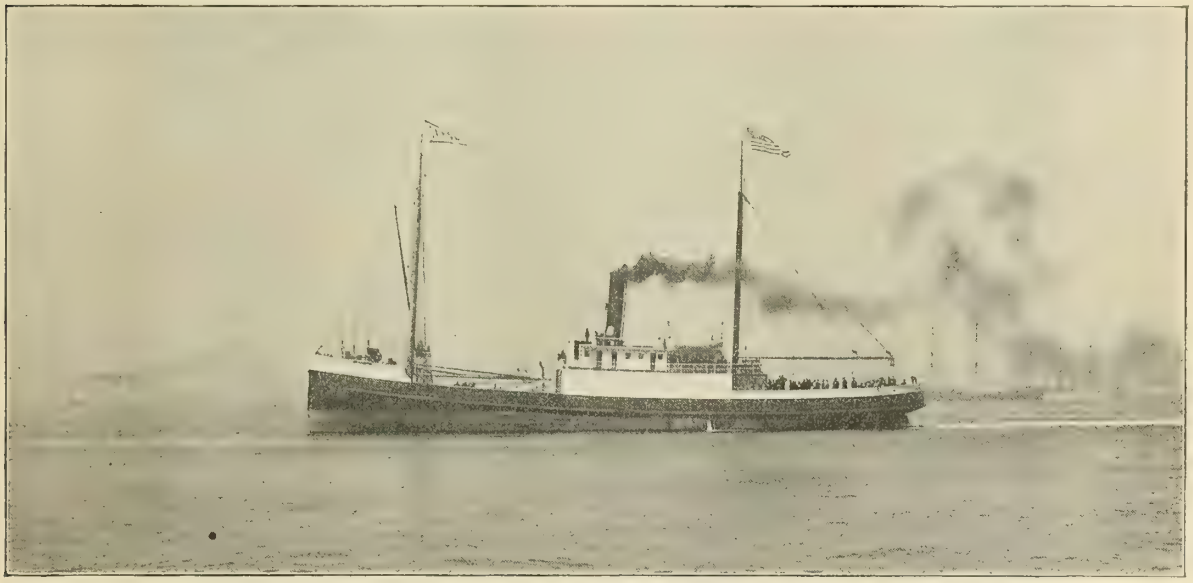
WIRELESS TELEGRAPHY.—The Board of Naval Officers appointed to investigate the use of wireless telegraphy for the Navy have recommended that it be adopted, and that the use of homing pigeons be discontinued. They suggest that a competitive test of the various systems be made and that two stations be established for training operators. The Marconi Wireless Telegraph Company of London propose to establish a service from London to Australia, with stations at the Lizard, Cape Finisterre, Gibraltar, on the Mediterranean and Red Seas, and on the islands of Ceylon and the East Indies.

DESCRIPTION OF THE STEAM SCHOONERS ENGAGED IN THE PACIFIC COAST TRADE.

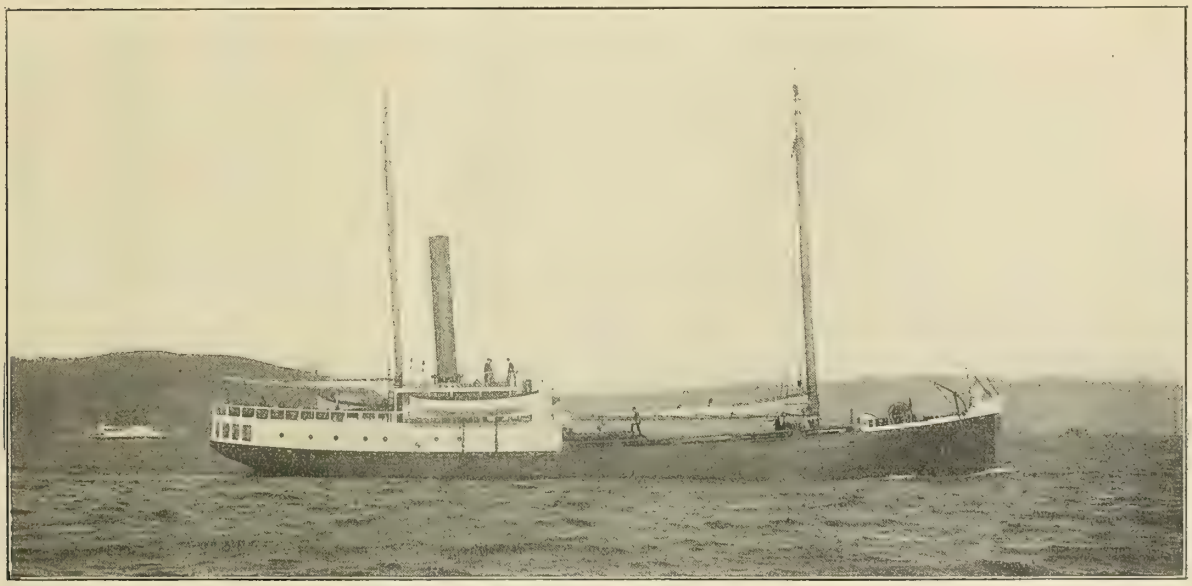
BY D. S. KIMBALL.

The western slope of the Coast Range Mountains in California, from the Monterey Bay on the south to the State line on the north, a distance of about 300 miles, is covered to a great extent with vast forests of giant redwoods. While this wood is not strong in texture it is valuable for light work, such as house building, and also for ornamental purposes. In some counties, Humboldt and Mendocino, lumbering is the principal industry. Saw mills are located quite thickly all along the coast, particularly on that portion north of San Francisco, and the methods and appliances used in handling these great trees, which often reach a diameter of 20 ft. both at the mills and in the woods, are most interesting.

One great market for the product of the mills is at San Francisco, and the problem of transportation was one of the first to be solved in establishing the industry. The water route offered the best solution, but it was beset with many difficulties.

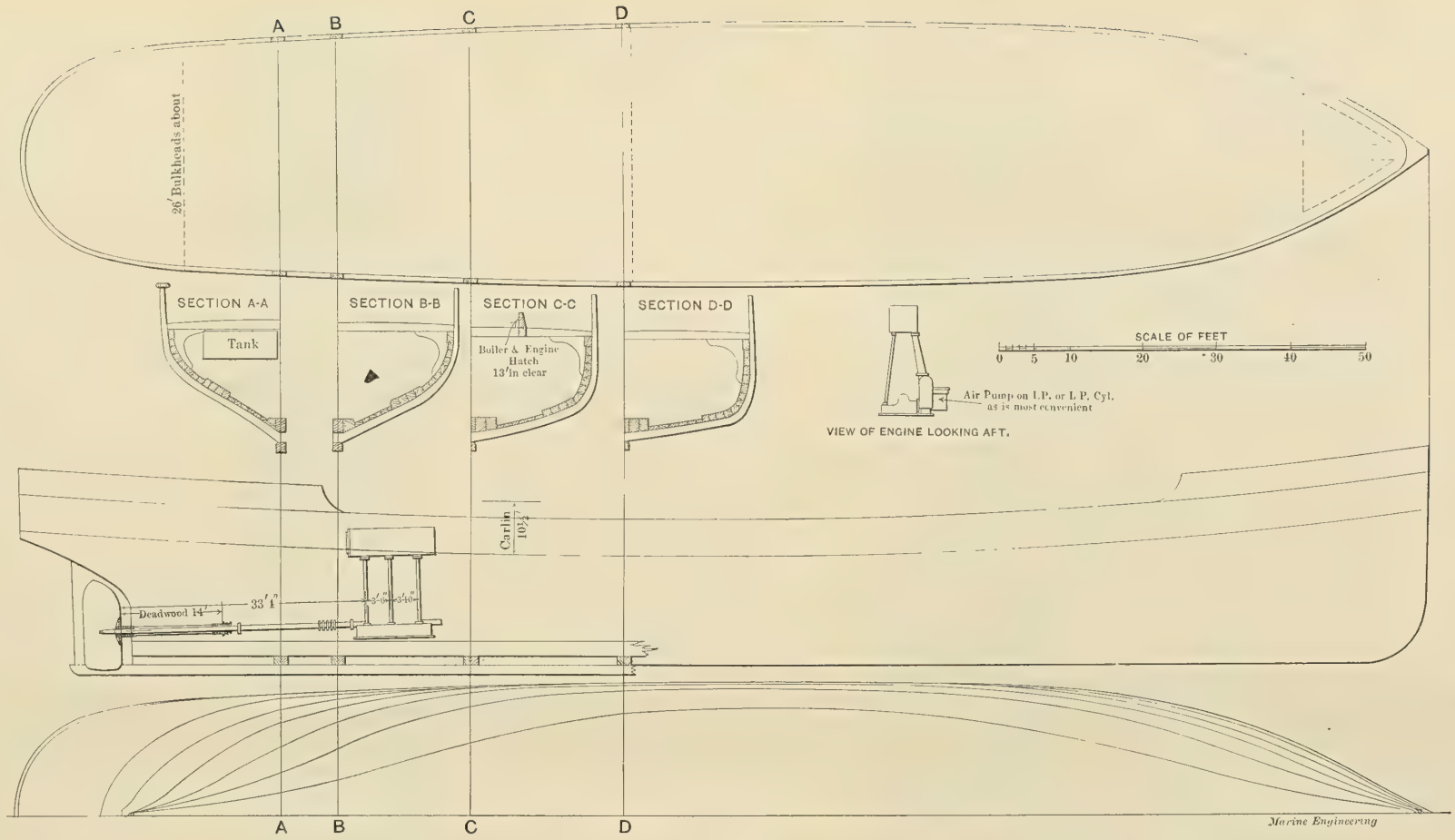


STEAM SCHOONER WEST COAST IN THE PACIFIC COAST TRADE.



STEAM SCHOONER SANTA ANNA BUILT FOR THE PACIFIC COAST TRADE.

From San Francisco north to the State line the coast is almost devoid of harbors, the only one of any importance being Humboldt Bay and this is obstructed by a bar. It is along this rocky and dangerous part of the coast that the greater part of the lumber is loaded on vessels and the problem of getting the cargo aboard the



LINES AND SECTIONS OF PACIFIC COAST STEAM SCHOONER SANTA ANNA.

ship was, in places, a difficult one. Very naturally, small sailing vessels were used at first, and such craft are still in use for certain branches of this trade. But the dangers of loading soon pointed out the necessity of a steam vessel of some kind, and the result has been that a peculiar type of steam vessel, commonly known on the coast as a "steam schooner," has been evolved. These schooners are fitted with both sail and steam as motive power, and their general appearance is clearly shown by the accompanying illustrations.

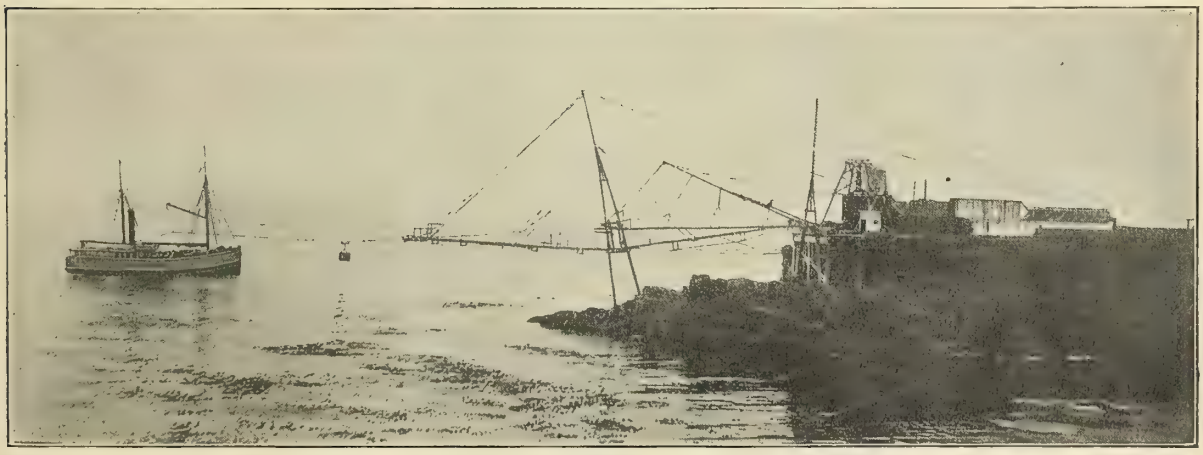
As the country filled up around the lumbering settlements many other industries were established, and as railroads do not penetrate to this part of the coast to any extent, the necessity of better communication with distributing points had to be met by these small coasting schooners. The freight and passenger traffic of this portion of the coast is now, to a large extent, carried in these so-called steam schooners. Conditions, varied

and changing, have affected the growth and development of these steamers, so that, at present, they include vessels which can make 8 or 10 knots under steam and

WIRE TRAMWAY FOR LOADING SCHOONERS ON THE PACIFIC COAST.

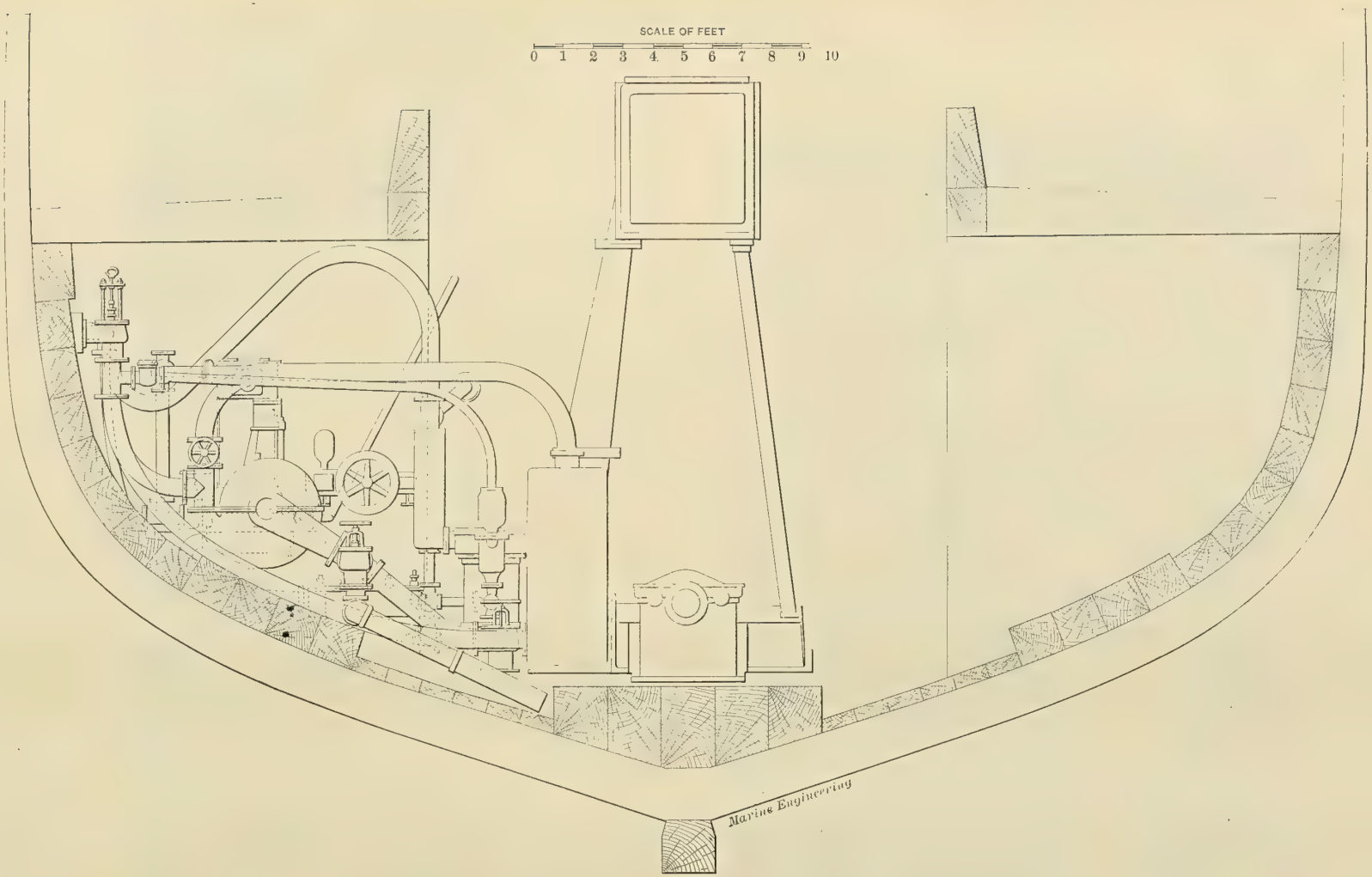
can fall back on their sails in an emergency. They are usually arranged to carry all classes of freight and have accommodation for a number of passengers.

At many points these schooners have to be loaded while they lie at anchor, just clear of the rocks, off the open coast. In such cases the cargo is conveyed to them by means of a wire tramway, which consists of a stout wire cable, one end of which is made fast aboard ship and the other end to a bluff on shore, and along which runs a two-wheeled trolley. From the trolley the lumber load, which is usually in comparatively short lengths, is suspended in a sort of cradle. At the shore end a wooden superstructure or loading scaffolding is erected and the load on the trolley is under control of the operators at this point. Such a position would be dangerous for a vessel propelled by sails only, but the steam schooner makes it possible to load lumber at what would seem almost impossible places. The runs made by these steamers are comparatively short; the winds during a great portion of the year are favorable on the downward trip, so that sails can also be used and the boats answer all the requirements of the traffic.



LOADING LUMBER ON SCHOONER IN THE PACIFIC COAST TRADE.

The inboard profile of the steam schooner *West*

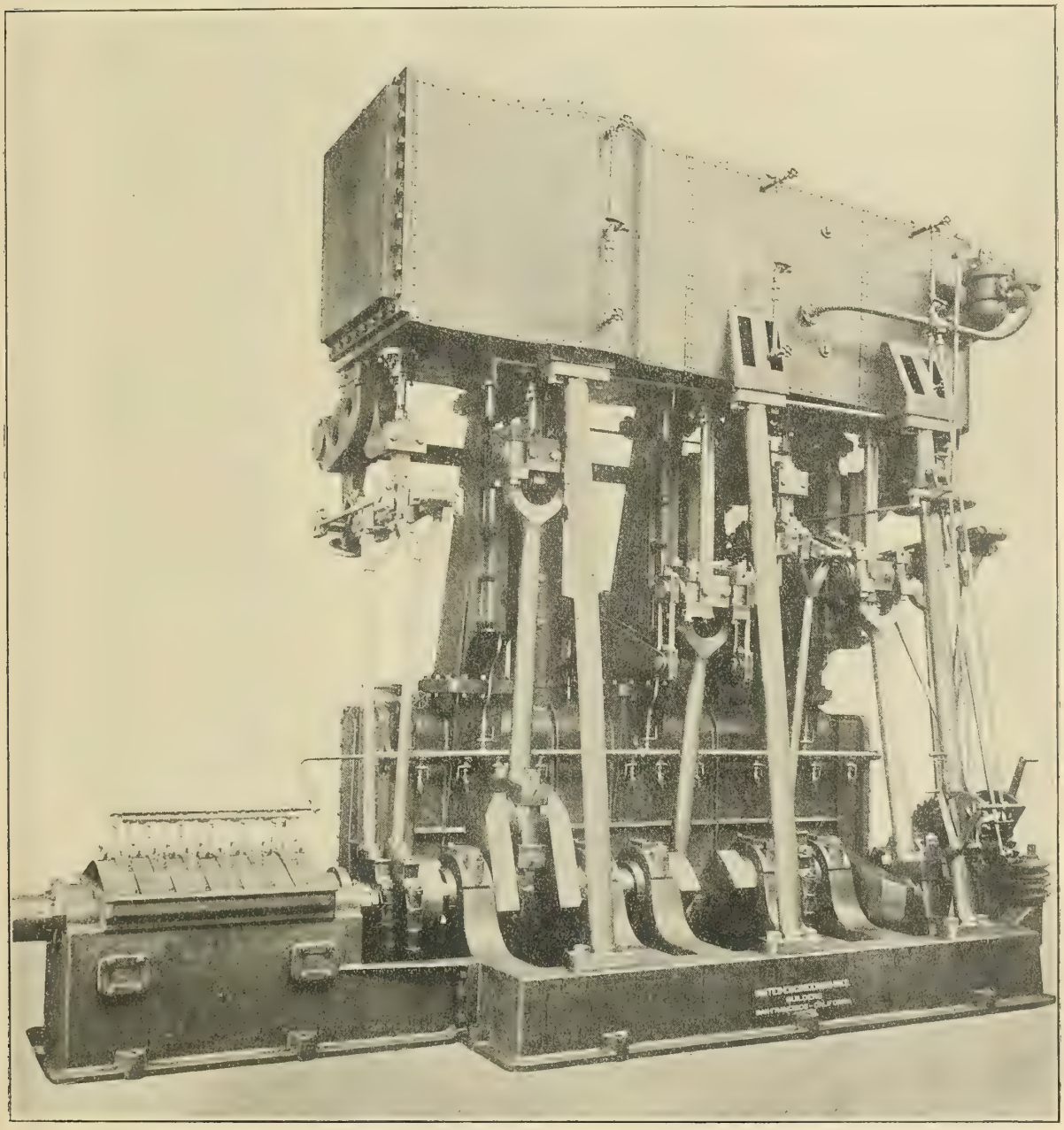


SECTION SHOWING ARRANGEMENT OF MACHINERY ON STEAM SCHOONER SANTA ANNA.

Coast, one of the first to be launched, is shown on page 238. This vessel, which was built in 1885, is 140 ft. long over all and 32 ft. beam. As can be seen the sail area is large. The deck houses are small, the main deck house being only 13 ft. wide, so as to give a deck space on each side for lumber. Deck space is valuable, as the greater part of the cargo is carried as a deck load. It will be noticed that the houses are placed so as to allow plenty of room for handling the sails. The propelling power consists of a 16 in. and 30 in. by 20 in. compound engine supplied with steam at 100 lb. pressure by a single ended Scotch boiler, 10 ft. dia. and 9 ft. 6 in. long.

As the trade grew and provision for passengers had to be made, larger vessels were built and the deck houses

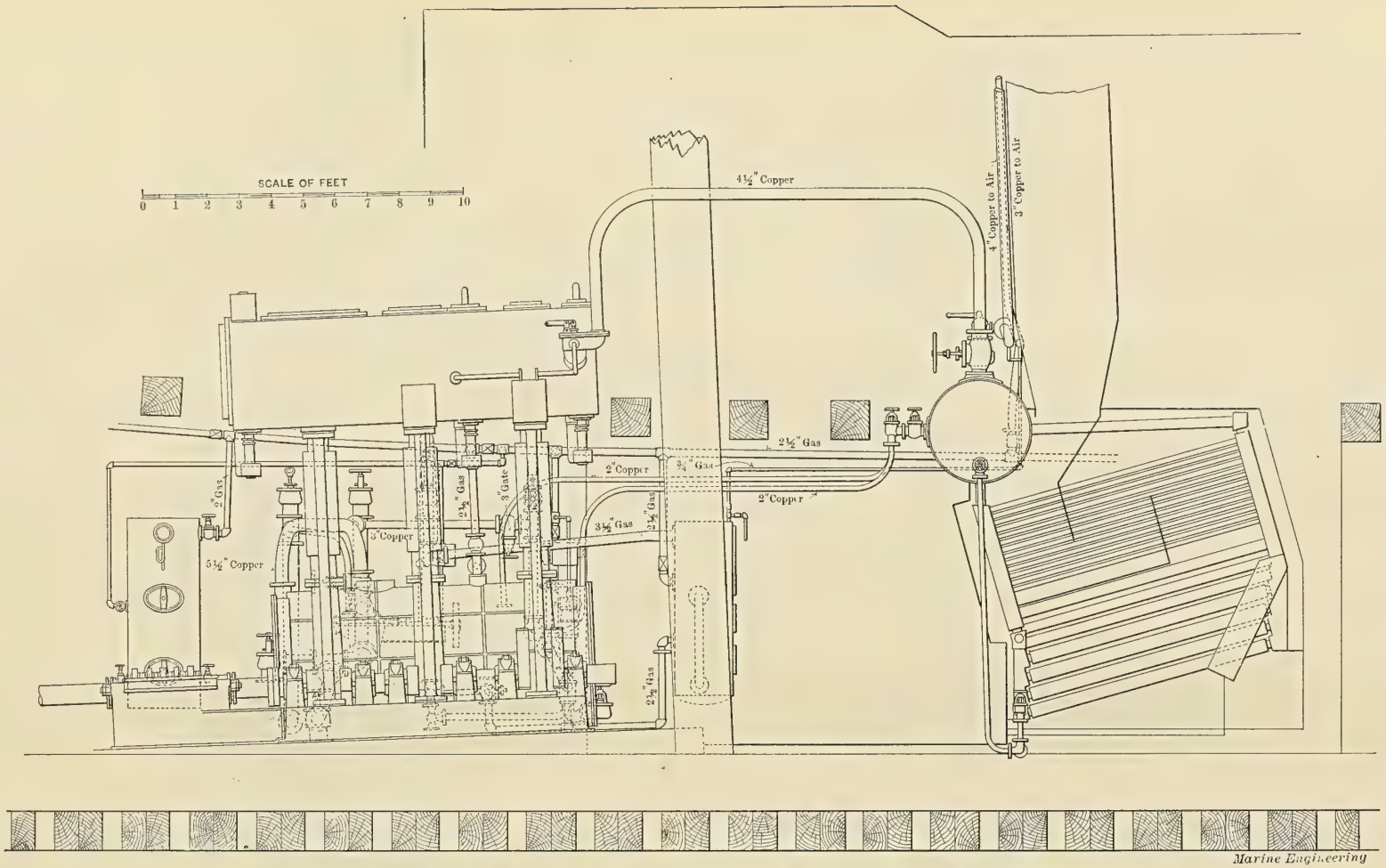
were modified somewhat. On page 238 a similar drawing of the *Santa Anna* is reproduced. This vessel was recently built and the change in deck houses is apparent as well as the progress in boilers and engines. Deck houses are now usually roomy and capable of accommodating a number of passengers. The general arrangement of houses is of course modified more or less by the requirements of the particular trade for which the vessel is intended.



TRIPLE EXPANSION ENGINE OF STEAM SCHOONER NOME CITY.

As the size of hull was increased larger and better machinery was placed in these vessels. Illustrations on pages 234, 236, 237, show the hull and arrangement of machinery of the *Santa Anna* before mentioned. This vessel is 188 ft. long, 35 ft. beam, and is equipped with triple expansion engines of 650 H. P. They are supplied with steam from Babcock & Wilcox water tube boilers, making an up to date propelling outfit.

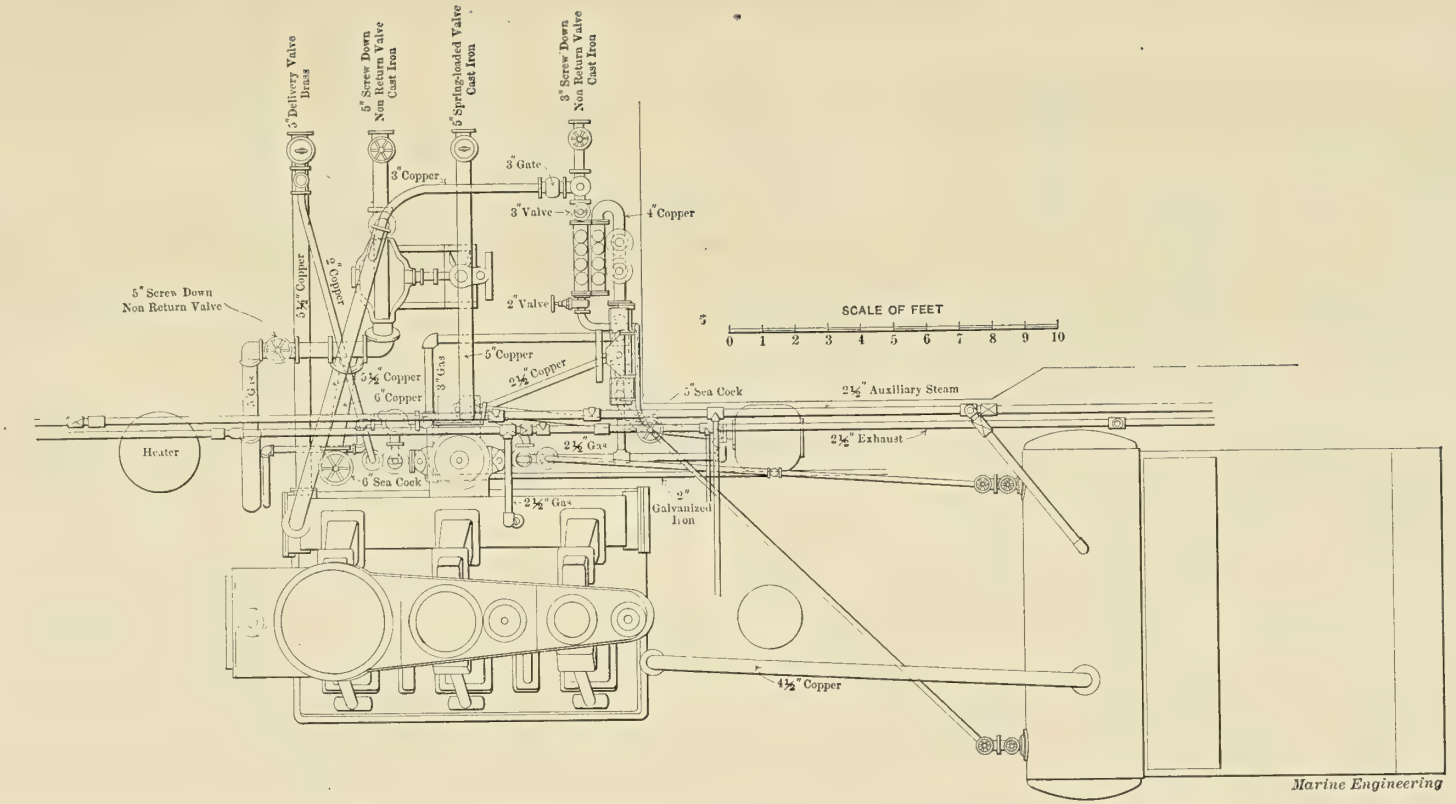
That still larger vessels can and will be used is evidenced by one recently constructed, which was designed originally to carry 1,000,000 feet of lumber each trip, and to run to Humboldt County for redwood. Before completion, the arrangement of deck houses was altered and the vessel was afterward put on the run to Alaska under the name of *Nome City*. This ship is 230 ft. long, 38 ft. beam, and 17 ft. depth of hold. The propelling power is a set of 13 in., 22 in., and 38 in. by 30 in.



Marine Engineering

ELEVATION SHOWING ARRANGEMENT OF MACHINERY ON STEAM SCHOONER SANTA ANNA.

triple expansion engines, shown in the engraving on page 235. Steam is supplied by two Babcock & Wilcox water tube boilers at 175 lb. per sq. in. These engines are duplicates of those on the *Santa Anna* and *Iaqua* and are fairly representative of the best outfits in these steam schooners. The high pressure and intermediate pressure cylinders are fitted with piston valves and the low pressure with a slide valve. No rings are used in the piston valves. Steam reversing gear is provided, and the bilge, feed, and air pumps are directly connected to the I. P. crosshead. The thrust has six horseshoe collars, with independent adjustment and water circulation, and is secured to the bed plate of engine. Water circulation is also provided on the crosshead guides. Parsons white metal is used on all running surfaces. The crank shaft is forged steel, in one piece, 8 1-2 in. dia. with cranks 120 deg. apart. The engines are well built in every particular and fully up



PLAN SHOWING ARRANGEMENT OF MACHINERY ON STEAM SCHOONER SANTA ANNA.

to the requirements of even the best passenger boats. These new steam schooners are also provided with steam anchor and cargo hoists, and even with electric light outfits in some cases.

The hulls are all of wood, the fir timber found in Washington and Oregon being used and found to answer admirably. Wooden construction is preferable for this service where rocks and bars have to be constantly avoided, and the necessary lengths are easily attainable. The hulls are designed more for carrying capacity than for speed, as can be seen by the accompanying drawings.

The use of the steam schooner is confined almost exclusively to the coast of California on short runs of 200 to 300 miles. Some attempt has been made to build much larger vessels of the same type and run them to ports farther up the coast, in the lumber trade, but not with any apparent success, and the great trade of Puget Sound and the Oregon ports is handled almost exclusively by sailing ships. That they are a success on the runs where now employed is shown by the fact that new and larger ones are being continually built. Many of the hulls are built at Eureka, Cal., but all the machinery is built or supplied at San Francisco. The engines for the *Nome City*, *Iaqua* and *Santa Anna* were built by the United Engineering Works of San Francisco, to which concern the writer is indebted for the drawings and photographs here reproduced.

NOTES ON RECENT IMPROVEMENTS IN FOREIGN SHIPBUILDING PLANTS.*

BY ASST. NAVAL CONS. H. G. GILLMOR, U. S. N.

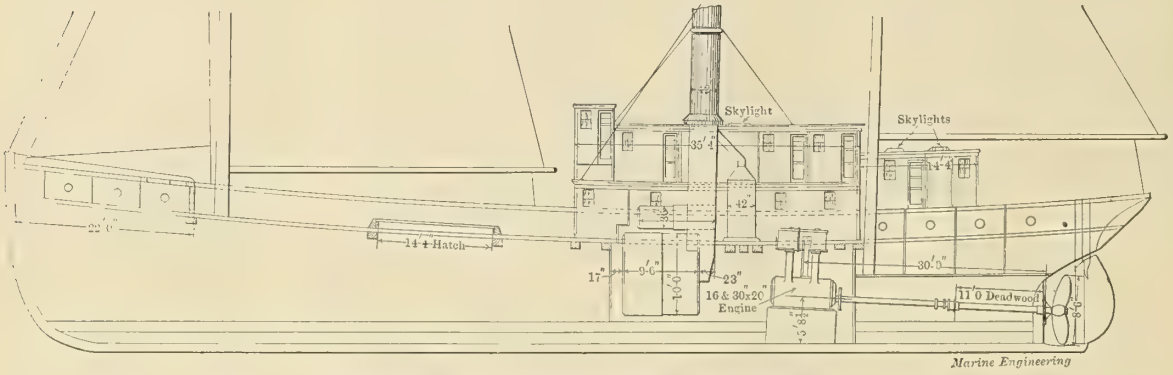
Among foreign shipbuilders, as among other manufacturers with whom America is in competition, the impression seems to be general that American plants and American tools are as far in advance as those of any country in the world. Having come, unconsciously, to accept this view, it was with some surprise, not unmixed with misgiving as to the possibility of presenting anything worthy of the Society's attention, that the Secretary's request for a short paper on this subject was received.

One shipbuilding plant is, at first sight, very much like another, whether it be in America, in England, or in any other country. It is possible, in shipbuilding, to do with plant of value proportionately so small, as compared with the value of the product output, that often the plant is almost forgotten in the interest in the work being done. If, then, what follows lacks in interest, or if there be little information contained, attribute as much as may be to the limitations of the subject.

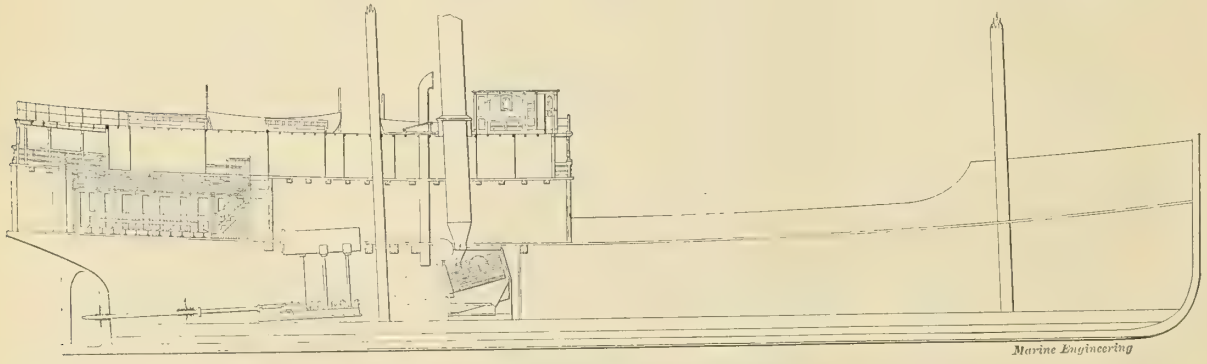
*A paper read at the eighth general meeting of the Society of Naval Architects and Marine Engineers, held in New York.

It is based upon observations made during visits to foreign shipbuilding yards during the years 1891 to 1894, as compared with those made during recent visits in the years 1898 to 1900.

Of the general arrangement of plants there is not a great deal to be said. Many, if not most, plants have been developed from modest undertakings of individuals, their arrangement, in the first instance, being dictated by the character of the ground and the means at command. In expanding to meet the requirements of increasing business, the best possible, under the circumstances, has doubtless been done; but in few cases is the arrangement the best possible with the given space, nor that which the responsible heads would have made had they been able to lay it out in the beginning on the basis of the present business.



INBOARD PROFILE OF STEAM SCHOONER WEST COAST.



INBOARD PROFILE OF STEAM SCHOONER SANTA ANNA.

The increasing size and length of vessels ordered has, in many cases, forced a rearrangement of yard and plant, and in all such rearrangements the working shops have been brought as near as practicable to the ships, and an effort made to make it possible for the material in preparation for the ship to follow a more or less regular course through the shops with as little handling as possible.

In connection with the arrangement, and before

touching upon the question of plant, it may be pointed out that the effect of trades unionism is nowhere more to be seen than in the development of shipbuilding plant in England. Practically all the steel work about a shipyard is paid for by the piece, and the resistance of what is known as the Boiler Makers' Society, a combination of all the iron and steel workers of the shipbuilding and boiler making trades, to all reductions in piece prices is so great, and their power is so felt among the shipbuilders, that it is impracticable to secure any adequate reduction in the cost of labor from improving the facilities for carrying on the work.

It might be argued that it would be in the interest of the shipbuilder to improve facilities, in order to increase the output of his plant, even though he should get no direct return through reduction in cost of production. Unfortunately, it is too often the case that not even this return comes to the enterprising shipbuilder who improves his plant, for the broken time from which they suffer so much increases with the possibility of increase in earnings of the skilled artisans of the shipbuilding trades. This should be borne in mind when considering the advances made by English shipbuilders, for there are many enterprising ones who would have gone much farther in their improvements had the conditions been such as to make it possible to get any adequate return for the expenditure required. What has been said of the effect of trades unionism does not apply to the same extent to German yards, and, as a rule, perhaps also partly through their being newer, one finds in them better arrangements and more labor saving appliances.

There was probably no form of industrial plant more wasteful of power than the average shipbuilding plant of ten or twelve years ago, when, ordinarily, steam was generated in one or more centers in the yard and distributed by a more or less badly kept system of piping, very wasteful at best, and only too often in difficulties. The possibility of an improvement in this direction which could be made to tell directly upon the cost of production has been felt by the foreign shipbuilders, and among the most important and extensive changes which have been made in most plants in the last decade are those in the direction of improving and increasing the economy and efficiency of power generation and distribution. The most striking features in what has been done in this direction is the increasing tendency to do away with the steam engine and the piping system necessary to its use. Its place, for many purposes in the shipyard, is being taken by gas or oil engines and by electric motors.

There are few foreign yards to-day in which the gas engine is not to be found doing work which was formerly done by the steam engine; and, in at least one large and important yard, steam has practically disappeared except for the hydraulic pumps and the yard locomotives. The municipal gas companies, in nearly all cases, supply illuminating gas for fuel and power at a somewhat reduced price. In many cases, however, some form of low grade fuel gas is made on the premises for gas engine consumption. The Dowson and similar processes by which a fuel gas, made up of hydrogen-carbon monoxide and the inert components of air, is produced from coke or anthracite, are generally employed for the purpose. So far as observed the engines used are, for the most part, horizontal single acting, single cylinder engines, working at from 120 to 180 revolutions per minute upon what is known as the Otto cycle, giving an impulse for every two revolutions. Their use for driving all the shops, such as the machine and fitting shops, joiner shops, etc., is becoming more and more general, and they may be found applied to almost every purpose in the shipyard to which the steam engine has been applied, except for the direct driving of isolated machines.

There seems little doubt that the advantages attending the employment of this type of motive power, under the conditions existing abroad, is more than sufficient to justify the outlay which the change in motive power involves. The managers of these yards in which gas engines are most extensively used express themselves as as well satisfied with them as mechanical agents. They point out also the very great advantage which they derive from the saving of space by the doing away with steam generators in those cases in which illuminating gas is used, or the relegation of the smaller gas generators used in other cases to the least valuable and useful space in the yard. In this connection it may be mentioned as a sign of the times that in one important German shipyard a considerable portion of the power of the shops is supplied by a pair of large Diesel oil engines.

While the gas engine serves very well for many purposes about the shipyard, it is not adapted to the direct driving of the several heavy machines, subject to more or less intermittent working, which have so prominent a place in a shipbuilding plant. In connection, then, with the changes in which the steam engine is supplanted by the gas engine for some purposes, it is not surprising to find its place for other purposes being taken by the electric motor. In the general industrial applications of electricity we are, in this country, well in advance of the old world; but in its application as a medium for the transmission and distribution of power in a shipyard, a great deal is being done abroad. Central electrical power stations have been established in, or are projected for, many, both of the larger and more important yards and of those less prominent in the industry. Dynamos of various types and manufacture are employed, though, so far as observed, they were direct current machines working at about 110 volts. They supply current for both light and power, and are driven both by steam and by gas engines, though steam engine driving is at present the more general.

There are numerous examples of electric motors having taken the place of steam engines for driving all the heavy and fairly widely separated tools of the plating shops. In many cases motor driving has been satisfactorily applied to machines not originally intended to be so driven. The employment of electricity to this purpose seems to have given entire satisfaction, and there are many yards in which, after trial in a small way, they are extending its application as rapidly as circumstances permit, with the intention of ultimately applying it to all the heavy machines of what may be called the shipbuilder's side of the yard. The motors have shown themselves capable of working

continuously or intermittently for long periods with, at any rate, not more attention than is generally required for steam engines employed for the same purposes, and provided with no other protection from the weather and the dust than a light wooden box or house with end panels of finely perforated tin or iron gauze.

It may also be mentioned that it has been found practicable to place the care and management of the wiring and motors in the hands of men, in some cases apprentices just out of their time, whose wage certainly would not entitle them to be designated highly paid specialists. The motors and their treatment would seem, at first sight, rather "rough and ready," but they do their work regularly and satisfactorily, and the system has made its way in an industry which is certainly not less conservative than many others. There are few examples of the driving of shop shafting by electric motors. The combination of gas engine driving, when power in large units may be employed as in shop driving with electric motors for the independent driving of isolated machines, or those of large size doing more or less intermittent work, seems to represent the most advanced practice abroad.

Hydraulic power is to be found in practically every yard in which vessels of any size are built. It is employed for the heavy flanging machines and manhole presses, and in many cases for operating the smaller cranes used in handling the heavy work at the machines.

Toward improvement in appliances for handling materials at the ship, with perhaps two notable exceptions, little has been done in recent years. Comment upon this fact usually elicits the reply that it is useless to provide the workmen with facilities which render the handling of plates, etc., at the ship, easier when it is not possible correspondingly to reduce the piece price paid for doing the work. In most cases a series of wooden derricks, distributed along the two sides of the building slips, with a winch each side at the head of the ship, to which whips or purchases may be taken, are regarded as sufficient to meet the requirements. In defense of the system, as compared with other and more elaborate arrangements for handling material, it is also urged that by far the greater number of individual pieces which have to be placed are of such moderate weight that the appliances at present provided are fully capable of doing the work, and that to have a number of such, to all of which work may be brought simultaneously, is preferable to employing some form of traversing crane or derrick. Light locomotive cranes, which may be employed both for handling cars in the yard and for picking up and transporting considerable weights, may be found a part of the equipment of many yards.

The standard shipyard tools abroad have suffered very little, if any, change in type for years. The increase in scantlings, with the ever increasing sizes of ships, has made an increase in size and power of these machines necessary, and at the same time their speed has been materially improved. The frame bevelling machine, an English invention, while in almost general use in Germany, is used to a much smaller extent in England. A plate joggling machine for joggling edges and butts, and so doing away with liners for the raised strakes, has come into very general use in England. There are also some very ingenious plate scarping machines in use where lapped butts are worked. New and special designs of plate drilling and countersinking machines, rolls, etc., are also fairly numerous.

Of the tools of the so-called fitting shops and the joiner shop it may be said that, in a general way, the improved tools adapted to the work of each have been introduced to a moderate extent, and it is gratifying to Americans to find that in these shops many of the newer machine tools are of American manufacture. In many foreign yards a great deal of work, which would otherwise be done in the fitting shops, is let out to concerns making a specialty of that sort of work, so that the fitting shop becomes less important than it would otherwise be.

In the employment of portable tools at the ship very little has been done. There are considerable numbers of portable electrical drilling and countersinking machines in use even in some yards in which electricity is not employed for other purposes. Portable hydraulic riveters are also employed to a considerable extent for riveting up frames, floors, and longitudinals, generally at the building slip itself. Portable pneumatic tools, however, although used to a considerable extent in boiler shops, have thus far found an extremely limited adoption in the shipyards.

Sch. Martha P. Small.—The five masted schooner *Martha P. Small* was recently launched from the yard of Percy & Small, Bath, Me. The schooner is of these dimensions: Length, 264 ft.; beam, 45.7 ft.; depth, 21.5 ft.; gross tonnage, 2,178 tons.

Frigate Minnesota to be Sold.—This famous frigate, the last of the *Tennessee* class, is to be condemned and offered for sale. She has of recent years been used by the Massachusetts Naval Militia in Boston Harbor, but is now unseaworthy, and the militia have notified the Navy Department that they have no further use for her. She was built in Washington in 1855, participated in the engagement between the *Merrimac* and the U. S. squadron at Hampton Roads, and was only saved by the timely arrival of the *Monitor*. She was also in the squadron which attacked the Shinoneseki forts.

Coast Shipyards Combination.—The United States Ship Building Company has been incorporated under the laws of New Jersey to acquire the properties of the Newport News Ship Building and Dry Dock Company, of Newport News, Va.; the Union Iron Works, of San Francisco, Cal.; the Bath Iron Works, Limited, and the Hyde Windlass Co., of Bath, Me.; Lewis Nixon's Crescent Shipyard and Samuel L. Moore & Sons Co., of Elizabethport, N. J., and the Canda Mfg. Co., of Carteret, N. J. The board of directors will include the leading men of these companies and other well known financiers. The company will issue $32,500,000 7 per cent non cumulative preferred stock, and $32,500,000 common stock. The aggregate of orders now placed with these companies amounts to over $60,000,000. The annual capacity of the new company is estimated at 380,000 tons, exclusive of repair work. It is also reported that the Vickers Sons & Maxim, Bethlehem Steel Co., and William Cramp & Sons Ship & Engine Building Company, are to be consolidated.

THE TWIN SCREW EXPRESS STEAMER DEUTSCHLAND.

Built By Stettiner Maschinenbau-Aktiengesellschaft Vulcan.*

Among the great strides which the German industries have made within the last ten years, that of shipbuilding has taken a prominent position. This industry was in its infancy thirty years ago, and during this short time it has assumed such proportions that it has made Germany entirely independent of foreign builders. In addition to this phenomenal growth the record of her shipyards during this time has been a very praiseworthy one, as they have not only managed to equal the product of foreign yards, but latterly have exceeded them and have gained an advantage which the latter will find difficult to overtake.

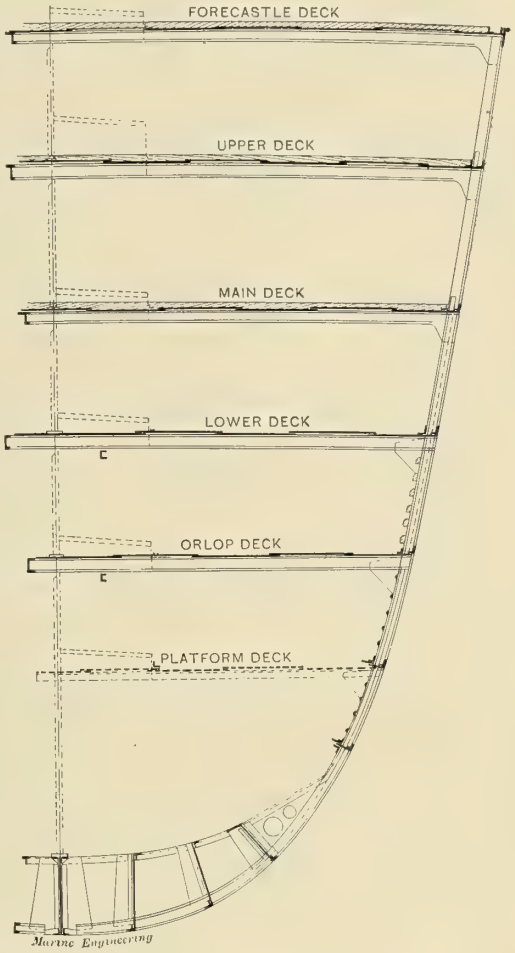
The largest German shipyard, the "Vulcan," in Bredou, at Stettin, distinguished itself three years ago in building the express steamer, *Kaiser Wilhelm der Grosse*, and in the endeavor to follow up their success, received the order from the Hamburg-American S. S. Co. for the construction of the express steamer, *Deutschland*, which was launched January 10, 1900, and which recently, in a series of trips between Hamburg and New York, demonstrated that not only have the expectations been realized, but even exceeded.

The steamer *Deutschland* is built of the best Siemens-Martin steel according to the requirements of the Germanic Lloyds for the highest classification of four decked vessels. She has four funnels, two steel masts for signaling, lookout and cargo handling purposes, vertical bow and sternpost and elliptical stern. Her construction and equipment are in accordance with the rules of the German Government and of the United States for emigrant ships, also with the rules of the "Seeberufsgenossenschaft" in regard to distribution of the bulkheads and bulkhead stiffening, and also with the rules of the Imperial German Navy for auxiliary cruisers. Her length over all is 684 ft.; between perpendiculars, 662 ft. 9 in.; beam, 67 ft.; depth from upper deck beam to the top of keel plate, 44 ft.; carrying capacity, 5,840 tons at 29 ft. draft in fresh water, with a displacement of 23,200 tons and a registered tonnage capacity of 16,200 tons. In regard to her speed it was stipulated that for the first six trips across the Atlantic she must average not less than 22 knots with a mean draft of 26 ft. It was further stipulated that during a six hour preliminary trial trip and at a mean speed of 23 knots, her engines were to develop not less than 33,000 indicated horse power.

The keelson of the vessel is a plate 47 1-4 in. deep by 0.934 in. thick and a flat protecting keel plate 23 5-8 in. wide by 0.846 in. thick. In addition the vessel is fitted either side with bilge keels, each 177 ft. long, built up with a bulb plate 1 1-8 in. by 1-2 in. and two plates 19 11-16 in. by 0.47 in., which are flanged to the hull plating.

The different frame sections, here given, show the method of construction and arrangement of the deck beams, the stanchions and double bottoms. The stanchions are placed on every second beam; the boiler rooms differ from the engine rooms in so far as that they have no longitudinal dividing bulkheads and therefore have been fitted with special stanchions and struts between the boilers and also in the uptake spaces.

The laps of the hull plating are quadruple riveted from the upper deck to the turn of the bilge, triple riveted at the turn of the bilge and quadruple riveted from there to the keel. All these strakes are scarphed, with the exception of those in the double riveted strakes above the upper deck. A number of girders



SECTION THROUGH FORWARD CARGO SPACE.

of the double bottom are continuous fore and aft, so that the floors are riveted between them.

The 262 frames comprised in the length of the ship are spaced as follows:

Frame 0 to 96 = 29 15-16 in.
96 to 193 = 29 1-2 in.
193 to 245 = 29 15-16 in.
245 to 246 = 28 3-4 in.
246 to 247 = 27 9-16 in.
247 to 248 = 26 3-8 in.
248 to 249 = 25 3-16 in.
249 to 272 = 24 in.

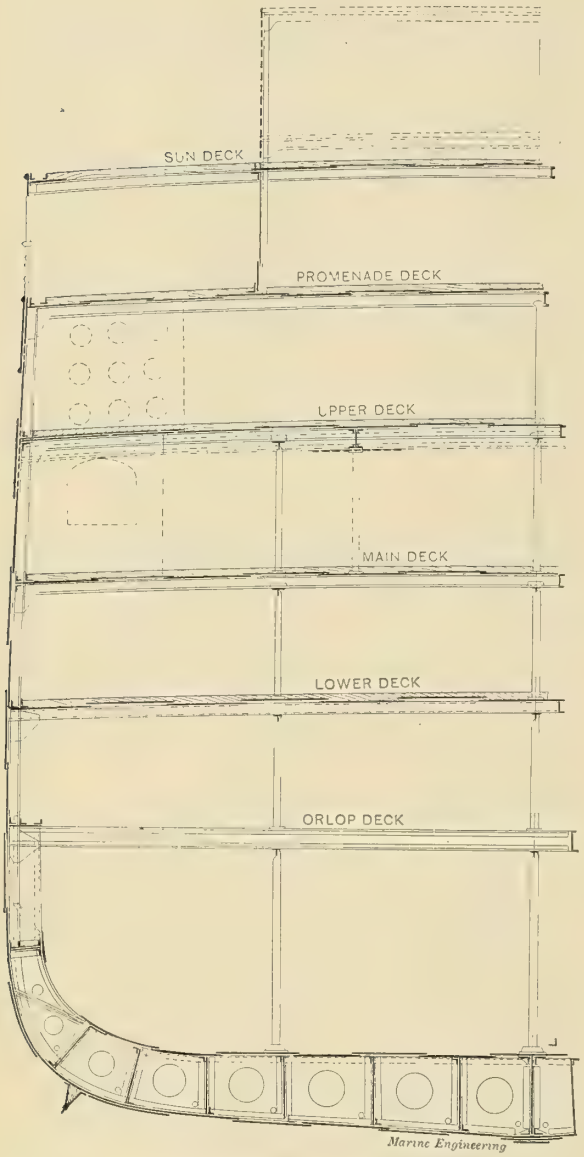
The frames have the following dimensions and shapes:

*Translated for MARINE ENGINEERING from *Zeitschrift des Vereines Deutscher Ingenieure*, November, 1900.

Frames in double bottom.

For the full floor plates, angles 3 15-16 in. x 3 15-16 in. x 9-16 in. for 3-5 of the length and 1-2 in. in thickness at ends.

Between these are { Channels, 7 7-8 in. x 1-2 in. x 3 9-16 in. x 11-16 in. for 3-5 of the length and Channels, 7 7-8 in. x 7-16 in. x 3 9-16 in. x 11-16 in. for the ends.



MIDSHIP SECTION OF S.S. DEUTSCHLAND.

For the water tight floors, double angle irons, 3 15-16 in. x 3 15-16 in. x 1-2 in.

Reverse bars in double bottom.

For the full floor plates, angles 3 9-16 in. x 3 9-16 in. x 1-2 in. for 3-5 of the length, and 1-2 in. in thickness at ends. Between these, 4 5-16 in. x 4 5-16 in. x 7-16 in.

In the engine room on every frame, 4 3-4 in. x 3 15-16 in. x 5-8 in. doubled, and under the boiler saddles, 4 3-4 in. x 3 15-16 in. x 9-16 in.

Double bottom floors.

1-2 in. plates on every second frame.

9-16 in. plates on every second frame in the boiler rooms.

9-16 in. plates in every frame in engine rooms.

15-32 in. and 1-2 in. bracket plates on every second frame.

Frames outside of double bottom.

Frames No. 57 to No. 206, channels 7 7-8 in x 15-32 in. x 3 9-16 in. x 11-16 in. to upper deck.

Aft of frame No. 57 and forward of frame No. 206, angles 7 7-8 in. x 3 9-16 in. x 9-16 in. thick and at the furthest ends 15-32 in. thick, extending to the highest deck at their respective location, from No. 0 to No. 13 doubled at every frame and doubled to upper deck on every second frame from No. 13 to No. 25.

At watertight bulkheads, angles 3 15-16 in. x 3 15-16 in. x 15-32 in. doubled.

From upper deck to promenade deck, 7 7-8 in. x. 3 9-16 in. x. 15-32 in. angles, extending about 2 ft. beneath the upper deck.

For the web frames 3 15-16 in. x 3 15-16 in. x 9-16 in., single angles.

Reverse bars outside of double bottom.

For channel frames, 4 3-4 in. x 3 15-16 in. x 9-16 in. angles, to orlop deck.

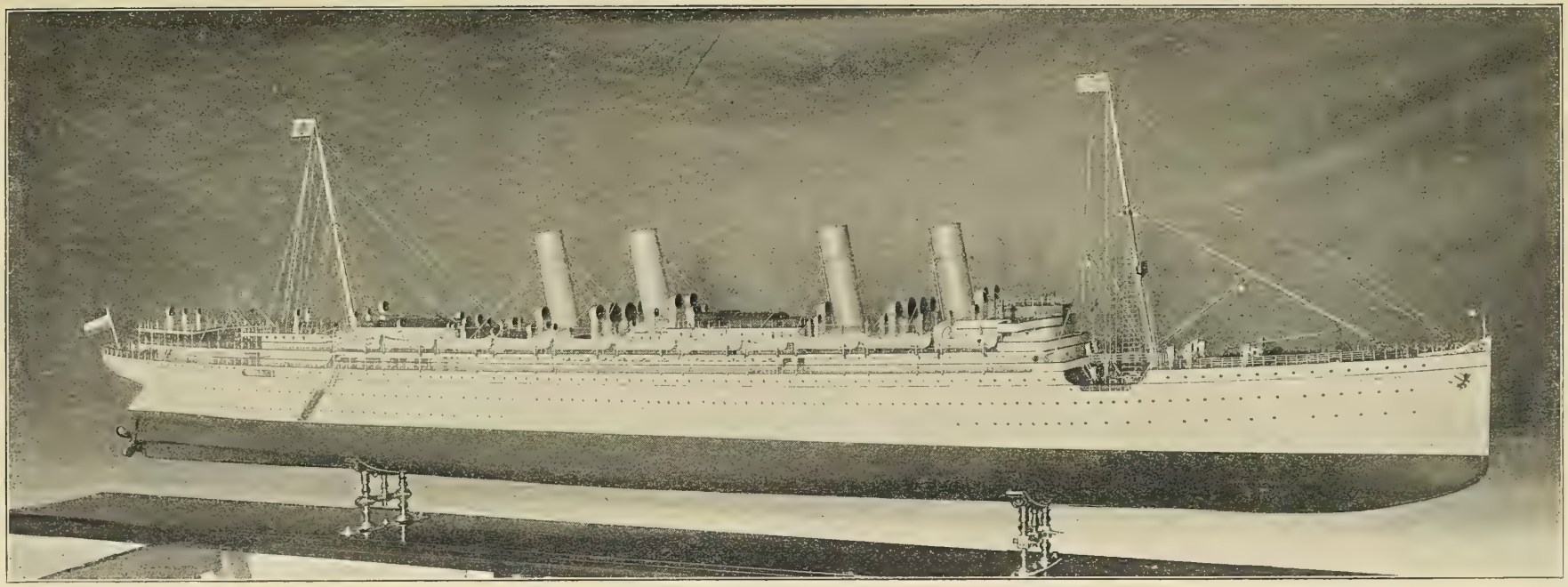
For angle frames, 5 1-8 in. x 3 15-16 in. x 9-16 in. angles alternating to upper deck and 12 in. above the main deck; in the forecastle, alternating to forecastle deck and 12 in. above main deck and doubled to the orlop deck.

On belt frames, 5 1-8 in. x 3 15-16 in. x 9-16 in. double angles.

The belt frames in the engine room are on every second frame and extend alternately to the upper deck and lower deck and in the boiler rooms are on every third frame extending to the main deck; on the cross bunkers on every third frame extending to orlop deck and in the freight spaces on every eighth frame extending to orlop deck.

The stem is an iron forging and is connected to the keel plate by an intermediate piece of cast steel. The sternpost and rudder post are of cast steel with eyes for the pintles of the rudder, which is likewise a steel casting. The stem weighs 17,200 lb., the stern frame 181,000 lb., and the rudder 59,500 lb. The rudder as well as the entire steering gear is below the water line in order to protect it from the enemy's fire in case the vessel is used as an auxiliary cruiser. The rudder stock runs through a detachable cast steel tube with a bronze sleeve; the rudder heel rests in a steel step and works on a hardened steel step piece. The three steel rudder pintles are detachable from the rudder lugs, are lined with bronze and work in white metal lined bearings in the lugs on the rudder post. The rudder stock is cast with five ribs which hold the 1 5-16 in. rudder plates. There are two plates to the rudder and these are attached to the ribs with double zigzag riveting. The steering crosshead is attached to the top of the rudder stock in the usual manner by means of feathers and keys.

It may not be out of place to introduce a few figures of the launching, which took place on January 10,



MODEL OF THE S.S. DEUTSCHLAND OF THE NORTH GERMAN LLOYD CO.

1900, in the presence of His Majesty the Emperor. Up to that time the weight of the vessel was 9,300 tons. The launching ways for this enormous weight, of course, were very strongly built and had an angle of inclination of 1 to 55. Each of the two cradles was 581 ft. long and was 3 ft. 7 3-8 in. wide for 548 ft. of its length and 4 ft. 8 in. for the remainder. The total area of each amounted to 2,108 sq. ft. and sustained a pressure of 2.21 tons per square foot.

The launching went very smoothly and took place in 54 seconds.

No less than 10,600 lb. of material was required to grease the ways.

The vessel has the following decks:

Name.	At amidships from top of deck beam to top of deck beam.
Upper sun deck	8 ft. 0 in.
Lower sun deck	8 ft. 0 in.
Promenade deck and forecastle deck	9 ft. and 8 ft. 6 in.
Upper deck	9 ft. 0 in.
Main deck	8 ft. 0 in.
Lower deck	7 ft. 6 in.
Orlop deck	

Of the four last named decks the upper deck, main deck and lower deck run from stem to stern, while the orlop deck runs from the stem to the forward bunker and from the stern to the after engine room bulkhead.

The different decks are sheathed, according to location, with 2 in. and 3 in. teak, Oregon or yellow pine. The forecastle is 118 ft. long and is fitted with two breakwaters 30 in. high and 15-32 in. plate. The main deck house is 407 ft. and the poop 115 ft. long. The decks of the two last named structures are connected by means of the promenade.

The vessel is divided into 17 watertight compartments by means of 15 thwartship bulkheads and one longitudinal bulkhead between the engine rooms, all extending to the upper deck, and will float if any two adjoining compartments are bilged.

Every compartment has a hatch or trunk for entrance or exit so that the watertight doors may be

kept closed, which is usually done during the night and in foggy weather, also in bad weather when navigating dangerous channels, thus increasing the safety of the ship and passengers.

Among the other life saving appliances are the twenty-six lifeboats which are stowed on the upper decks. Of this number eighteen are of the Francis patent, built of galvanized iron. Sixteen of these are 30 ft. long and 8 ft. 9 in. beam and two are 26 ft. long by 7 ft. 9 in. beam. Furthermore, there are two wooden boats 19 ft. 9 in. by 5 ft. 11 in. and six collapsible boats 26 ft. by 8 ft. In order to be prepared for any emergency four of the boats are hanging continually in the davits, and these may be quickly handled by four small boat winches, each of 6 in. diameter of cylinder and 10 in. stroke, located on the lower sun deck.

The double bottom extends from frame No. 26 to frame No. 241 and is divided into twenty-two tanks, of which the four located under the boilers have a capacity of 82,000 gallons of fresh water for auxiliary feed and the two located aft of the engine room have a capacity of 62,200 gallons of fresh water for domestic use. In addition to this quantity the tanks located alongside the shaft tunnels have a capacity of 45,000 gallons of drinking water. The capacity of the remaining ballast tanks, including the fore peak and after peak, is about 90,000 cu. ft., or about 2,570 tons of salt water.

The main bunkers, extending from frame No. 90 to frame No. 207, have a capacity of 4,820 tons of coal. The bunker plating is of 5-16 in. plate and is stiffened by gussets and thwartship bulkheads and the floor is cemented from end to end. This large coal capacity can be increased by filling the hold compartment forward of the main bunkers, as this space has been arranged so that it can be used as a spare bunker. On each side of the vessel between frames 95 and 142 and 152 and 204, tracks are laid so that the coal can be brought to the stokeholds by means of hand cars.

In comparison to the bunker capacity, the cargo capacity is exceedingly small. The cargo space forward has a capacity of 51,000 cu. ft. and the space for baggage, including the space for provisions and refrigeration, is 23,600 cu. ft.

The crew numbers 543. Among these are 15 ship's officers, including post office officials, one surgeon, one purser, one chief steward, 53 engineers, assistants and oilers, 201 firemen, 218 stewards and cooks, 54 sailors including carpenters and quartermasters. For the personal use of the captain a suite of rooms consisting of a sitting room, bedroom and bathroom has been provided, located on the lower sun deck forward of the forward funnel. Adjoining this are the officers' rooms and above them the bridge with wheel house and chartroom, so that the captain and his officers are always near to their posts of duty. The rooms of the engineering staff are similarly arranged, as they are located near the engines. The rooms of the engineers, assistants and oilers are on the upper deck on both sides of the engine hatches, and the firemen's quarters are on the lower deck aft of the engine room, arranged in three compartments, one for each watch. The engineers' rooms are on the upper and main deck near the forward engine room bulkhead. The deck officers are located on the main deck forward and the rooms of the stewards, surgeon, etc., are suitably distributed in the different parts of the ship.

The accommodations for the first cabin passengers are on the promenade deck, upper deck and main deck forward and amidships, consisting of 260 staterooms with a capacity of 693 passengers. These rooms are all arranged for comfort, as they are fitted with electric lights and electric call bells, steam heat, forced ventilation and electric thermostats. Some of them are arranged as suites, consisting of sitting room, bedroom and bathroom, and 50 of them are arranged each for one person only, the latter arrangement being especially intended for ladies or gentlemen who are traveling alone. The second class accommodations consist of 99 rooms with 302 berths, located aft on the upper, main and lower deck. They are somewhat simpler than the first class rooms, but have all the conveniences. There is accommodation for 288 steerage passengers in the different compartments on the lower deck, making a total accommodation for 1,826 persons, crew and passengers. To give an idea of the provisions required for a round trip Hamburg to New York and return, there are required: 38,600 lb. of meat, 9,900 lb. of fowl and game, 66,000 lb. of potatoes, 44,000 lb. of flour and a large quantity of vegetables, fish and other eatables and drinkables.

For every class of passengers as well as for the crew, separate galleys have been provided, each with its pantry equipped with hot closet, coffee and tea urns, refrigerators and washing utensils. The galleys are all fitted with steam jacket kettles and the most modern stoves. Furthermore there is a bakery, pastry and confectionary kitchen, each with several bake ovens, also a butcher shop. Medical aid and medicines are provided free of charge in case of need. Several hospital berths are installed in the forecastle. The marine post office sorting rooms are located on the upper deck aft of the port engine hatch. A small printer's shop has also been fitted for printing menus and concert programs.

The facilities for bathing have received special attention, both for passengers and crew. Particular attention is called to the shower baths for firemen and trimmers, which add very much to the comfort of these men after their watch below.

The lavatories and other sanitary fittings are all supplied with running water.

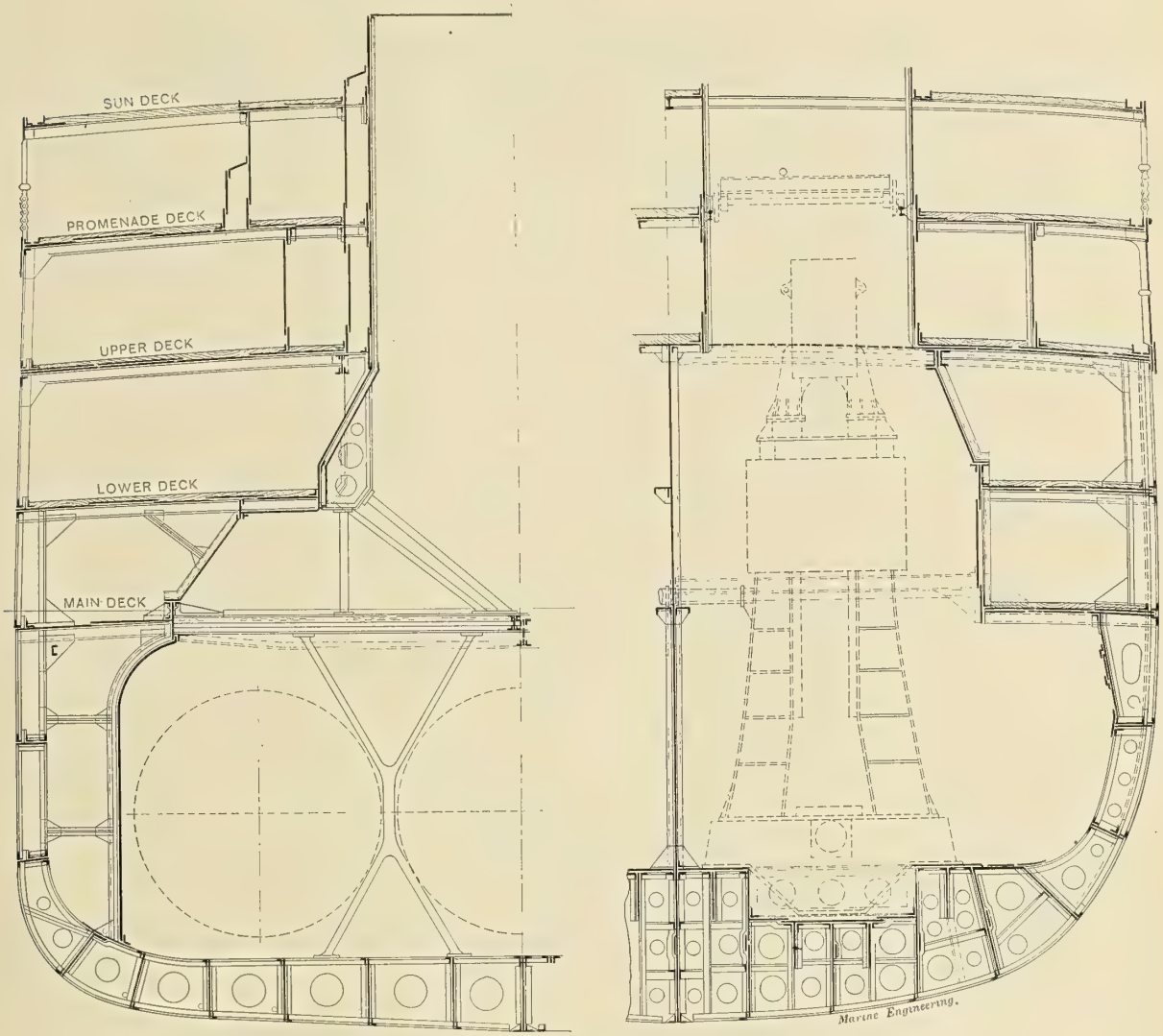
For the first cabin passengers there is a large main dining room and two auxiliary dining rooms, with a total seating capacity of 416 seats, located on the main deck amidships, also a breakfast room and children's playroom located on the lower sun deck with a social hall and smoking room on the promenade deck. The forward part of the promenade deck, which is used by first cabin passengers, is protected from the sun and weather for its whole length by the sun deck.

In regard to the artistic decoration, this vessel is a radical departure from the former express steamers renowned for their gorgeous decorative treatment. Instead of a profusion of mirrors on the walls and heavy detail decorations on the ceilings and gilt on the furniture, the aim has been to eliminate the oppressiveness caused by such profusion in the comparatively cramped spaces on shipboard and to produce an effect

such that the capacity of the different spaces is magnified. This has a soothing effect in comparison with the never ending motion outside. With the comparatively small distance between decks, the first effort has been made to produce the appearance of high ceilings by means of ceiling decoration. This effect is produced by light tints, which has been followed throughout both for walls and ceilings. The designs

ft. high, taking the place of the light and air shaft on older vessels. This extends through the promenade and upper deck and at the top has a bell shaped cover fitted with mirrors and stained glass windows.

The whole ship is fitted with steam heating, steam for which is taken from the auxiliary steam line and reduced to 45 lb. pressure by means of a reducing valve. The ventilation is accomplished by cowl ven-



SECTIONS THROUGH BOILER AND ENGINE ROOMS ON S.S. DEUTSCHLAND.

for the entire ship, embodying the above principles were supplied by the architect, George Thielen, of Hamburg. The rooms, with their modern architectural forms and artistic decoration, produce a very imposing impression, and at the same time have a comfortable appearance. The decorative work was carried out by J. C. Pfaff, of Berlin, and quite a number of painters and sculptors were employed in producing the pictures, ornaments, woodcarving and bronzes.

The most prominent decoration of the first cabin dining saloon is the glass dome, which is almost 30

tilators, air shafts and electrically driven exhaust fans. The electric power for lighting, ventilating and for several small hoists on the different decks, is furnished by three large dynamos of 700 amperes and two small machines of 400 amperes, all of 110 volts. The large dynamos are direct driven by vertical compound engines of 11.81 in. and 19.685 in. diameter of cylinders and 9.842 in. stroke, and the smaller dynamos by compound engines of 10.63 in. and 17.716 in. diameter of cylinders by 7.874 in. stroke. The total number of incandescent lights is about 2,500. One of the generators is located on the main deck near the for-

ward engine bulkhead and the others are located in a special dynamo room aft of the main engines and separated from same by a watertight bulkhead. In this same compartment is located a carbonic acid gas refrigerating machine manufactured by F. & C. Hall, Dartford, used for cooling the ship's meat supply. The leads are arranged independently to each cold storage box and a temperature of 23 deg. Fahr. can be maintained in each.

(To be continued.)

LAUNCHES—HOME AND FOREIGN.

S.Y. ERMINA.—The steel schooner yacht *Ermina*, designed by A. Cary Smith, was launched from the yard of the Townsend & Downey Shipbuilding & Repair Co., Shooters Island, N. Y. The *Ermina* is 99 ft. on deck, 68 ft. load water line, 20 ft. beam and 12 ft. draft.

U.S.S. OHIO.—The first class battleship *Ohio*, building for the United States Government, was launched from the yard of the Union Iron Works, San Francisco, Cal. The launching was attended by President McKinley. The principal dimensions of the *Ohio* are: Length on load water line, 388 ft.; extreme beam, 72 ft. 2 1-2 in.; mean draft, 23 ft. 6 in.; displacement, 12,230 tons. She will be fitted with twin screw triple expansion engines and twelve Thornycroft boilers. The *Ohio* was contracted for under Act of Congress May 4, 1898, the contract price for hull and machinery being $2,899,000.

S.S. M. S. DOLLAR.—The first steamship to be launched from the yard of the New York Shipbuilding Co., Camden, N. J., was the *M. S. Dollar*, which was launched on May 4. The launching was a great success, the ship being christened by Miss Marie Morse, a daughter of the president of the company, Henry G. Morse. The new steamship, which was built for the Robert Dollar Company, of San Francisco, Cal., is of these dimensions: Length, 310 ft.; beam, 40 ft., with a gross tonnage of 2,300 tons and speed of 10 knots. She will be fitted with a three crank triple expansion engine with cylinders 22 in., 36 in. and 59 in. dia., with a stroke of 42 in. and with two steel single ended boilers 14 ft. dia. by 12 ft. long.

S.S. LYRA.—The steamer *Lyra*, built for the Boston Towboat Co., was successfully launched from the Marine Department of the Maryland Steel Co., Sparrows Point, Md., recently. The launch was highly successful in every respect, and in less than one hour after the ship left the ways she was having her engines installed at the dock. The principal dimensions of the *Lyra* are as follows: Length over all, 350 ft.; length between perpendiculars, 330 ft. 6 in.; beam molded, 47 ft.; molded depth to main deck, 28 ft.; depth of water bottom, 3 ft. 4 in. The *Lyra* will be fitted with a single screw triple expansion engine with cylinders 21 in., 35 in., and 56 in. dia., with 42 in. stroke. There will be two single ended boilers, 14 ft. 6 in. dia. and 10 ft. 9 in. long, with 175 lb. steam pressure. Independent bilge, feed, circulating, fire and sanitary pumps of the Worthington make will be installed. The *Lyra* will be used as a regular ocean tramp steamer.

COPPERSMITHING, WITH SPECIAL REFERENCE TO MARINE PRACTICE.

BY WM. WEIGMAN.

The most important part a foreman coppersmith looks to is the cost of work and the avoidance of unnecessary labor, while at the same time there should be no room left for criticism, and above all, he should be very careful to examine every seam. This if strictly adhered to would avoid many unnecessary delays at the completion of the work. Another point would be to see that all pipes that are to be bent should have as large a radius as possible, for three reasons: First, the least amount of work; second, avoiding stretching the copper on the back; and third, which is very important, rounding the bend. This is where many pipes are slighted and looks very bad for the mechanic and for the foreman as well, to permit any such work to be placed in an engine room. If it should require a short radius, care should be taken by filling the pipe twice, and by doing this time would be saved for this reason. A pipe distorted in the bend, which will occur if bent by short radius, worries a mechanic and he strains every point known to make the pipe pass inspection. Now while he is trying all this to make the work look as it should, he could have avoided all trouble by filling it the second time and the result would be satisfactory both in finish and price. This only refers to pipes filled with rosin, such as exhaust and suction pipes, or any pipe of a light gage. All pipes of a heavy gage can be bent with sand. This is much quicker and avoids all puckers and delay in waiting for the pipe to get cold enough to bend, and remelting the rosin out of the pipe. Another important thing to mention is how cast iron flanges should be bored for copper pipe. The best method is to have the depth of the counterbore on the face of the flange, where the copper is turned, about 1-32 in. less than the thickness of the copper, so that when the pipe is hammered to the flange, the other third of the counterbore is filled and part of the copper projects above the face of flange, as shown in Fig. 1. The result is that when the joint is made the copper buries itself into the packing and thereby avoids a leaky joint. A coppersmith should never cut a clamp in the center of a bend, as shown in Fig. 2, and he should always avoid as many clamps as possible, for this reason; that in nearly every case where a leak is found, it generally is in the corner of a clamp, and the clamp in the center is one which is hidden from the coppersmith's view when he brazes. He must, therefore, depend entirely on the man who is keeping up his seam. If a bend is worked properly and according to lines laid down few clamps are required, say one at each end of the pipe. Then the outer edge of the seam is hammered and both ends and center of pipe are bound with wire to keep the seam from springing. Let us now examine the process of brazing two pieces of copper pipe together. This was very rarely done 15 or 18 years ago in marine coppersmithing, and in nearly every case where two or more pieces of pipe were put together it was done by soldering the joint, as in Fig. 3. This can yet be seen on some of the old side wheel steamers plying on the Chesapeake Bay, but since the introduction of triple expansion engines and high

pressure steam, marine coppersmithing had to meet its demands and the method known as the brazed cup joint, as shown in Fig. 4 is used. A basket made of sheet iron being placed around the joint, leaving about 5 in. space for charcoal, the blast is then turned on the top of the burning coal until the solder flows. Recently charcoal is being dispensed with and coke is used. Here a different basket must be used, as in Fig. 5. The holes shown in this figure must be kept opposite the solder and the basket filled with coke previously made hot on the forge. The hose or pipe leading from the fan must then be inserted in the nozzles, shown in Fig. 5, and must be watched very carefully, as in nearly every case the solder will flow all at once.

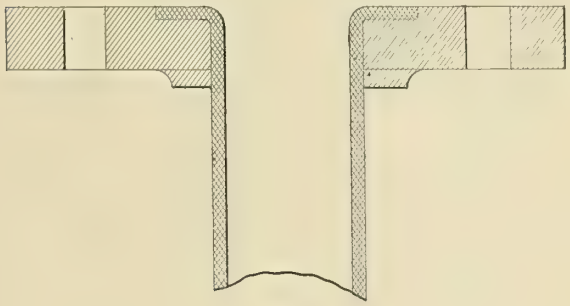


Fig.1

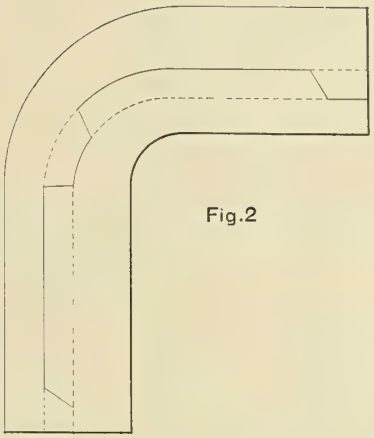


Fig.2

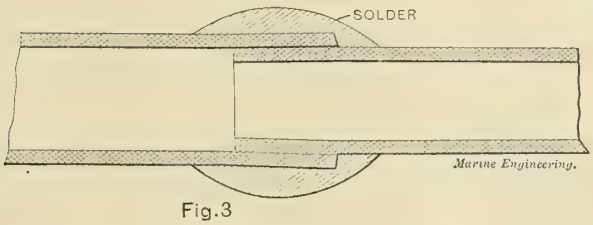


Fig.3

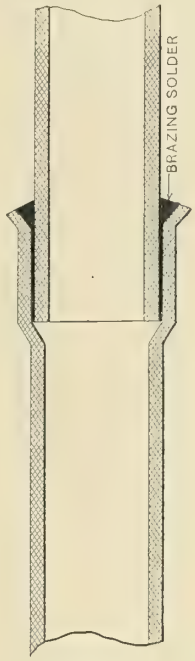


Fig.4

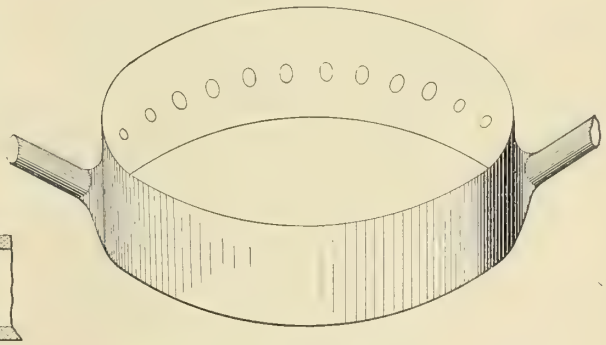


Fig.5

SKETCHES ILLUSTRATING MODERN COPPERSMITHING PRACTICE.

S.S. Saale.—The Townsend & Downey Shipbuilding & Repair Company, of New York, has been awarded the contract to rebuild and equip the *Saale* with new engines, shafting, etc. The *Saale* is one of the ships of the North German Lloyd line partially destroyed by the great fire in Hoboken last year, recently purchased by Lewis Luckenbach, of New York, and now to be rebuilt and operated as a cargo ship. The next lowest tender for the work of rebuilding this ship was submitted by The Newport News Shipbuilding Co. The *Saale* will shortly be removed from The Morse Iron Work Co.'s dock, Fifty-fifth street, Brooklyn, to the works of The Townsend & Downey Shipbuilding & Repair Co., at Shooters Island, N. Y. The *Saale* will be equipped with triple-expansion engines, 26 in., 43 in., 70 in. by 48 in. stroke. The time required for the extensive alterations and repairs to this ship will be about five months, and the cost of altering her to a cargo ship will be about $200,000.

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H. L. ALDRICH,
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PROF. W. F. DURAND,
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F. D. HERBERT,
Associate Editor.

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INDUSTRIAL combinations are the expression of the modern industrial and commercial spirit. The genius of the age runs with great aggregations of strength for the purpose of carrying on the world's work. It could hardly be expected that the shipbuilding industries would escape the influence of this spirit of the age, and in fact it is only surprising perhaps, that active and general symptoms have been so long in appearing. However, some two years ago the shipbuilders on the Lakes led off with a combination under the name of the American Shipbuilding Co., and to judge from all reports and from all indications the results have been highly satisfactory to the parties chiefly interested.

Since that time there has been no lack of rumors regarding shipbuilding trusts and combinations for the Atlantic coast, but until recently no visible result was forthcoming. Since our last issue, however, public announcement has been made regarding the general features of a combination taking in some half dozen yards on the Atlantic coast with the Union Iron Works on the Pacific coast. One feature which strikes the casual observer is the number of large concerns which still remain outside of the combination. The field of activity for a shipbuilding combination on the Atlantic and Pacific coasts is still very far from covered, and it will be interesting in the highest degree during the next few months or years to note the history of these concerns and of their relations to the combination.

Any one of several results may follow. The present "trust" may prove unstable and break, giving rise to new combinations; or these outlying concerns may be either gradually drawn in or extinguished, or ignored; or again they may be drawn together into a rival combination which in turn will either become absorbed by or will absorb its rival.

Recently the press has contained warnings of a new combination, especially for the construction of warships and their equipment, and beginning with a reorganization of the Driggs, Seabury Gun & Ammunition Co. Whatever may be the outcome in the immediate future it is safe to predict that the present combination will not be able to maintain an existence satisfactory to those most concerned so long as there exists so much of the field yet outside, and potentially capable at least of a most serious menace by the formation of a new and rival combination.

In the meantime the lessons which combinations have so well taught in other parts of the industrial world will doubtless receive fresh demonstration in the shipbuilding industry. These are in brief, that combination makes possible a decrease in the cost of production, and that such decrease is greater the more completely the various products dealt with can be standardized and simplified as to variety and number of types. It is this latter point which has given to the combination on the Lakes such an excellent opportunity for reducing the cost of production, and in a word for realizing the purposes for which the combination was effected. On the coast, however, conditions are by no means the same. The types are vastly more varied and complex than on the Lakes, and any attempt at standardization or reduction in types will be found of almost insuperable difficulty.

Still much can be done by a unification of methods of design, and also, perhaps, of auxiliaries, fittings, and equipment; also by a distribution of work to the various yards where it can be done to the best advantage, and in such amount as to keep the various yards running as nearly as may be at a rate corresponding to their best efficiency. In these and other ways the combination if well administered will doubtless be able to reduce costs

of production, but the problems which present themselves to the administration are vastly more complex than those arising on the Lakes, and are indeed such as will doubtless call for the best effort and most skilful guidance if a thoroughly satisfactory result is to be achieved.

With capital seeking an outlet in ships and shipping and with shipbuilders awakening to the possibilities before them, it would seem as though we might be on the eve of great developments in this direction. The "trust" is one of the instruments of modern industrial methods. Its application to the shipbuilding conditions on our coasts is an experiment in which we are all interested and which we shall all watch with the deepest and keenest attention.

ANOTHER chapter has been finished in the history of the Belleville boiler. The so-called "interim" report of the British Admiralty Committee has appeared, and as most of our readers have doubtless seen, it makes a clean sweep of the Belleville boiler so far as fitting it in new ships is concerned. In ships already completed and fitted they are to be retained and also in cases where a change would delay completion. Where a change will not delay completion they are not to be fitted, and for all new work they will not be fitted of course. In brief, the report recommends a complete and absolute abandonment of the Belleville boiler as an acceptable type for naval purposes. The fitting of these boilers on the scale in which it was undertaken was magnificent as an experiment with this particular boiler, but the experiment was not altogether a success, and the results are correspondingly disastrous. The British Admiralty have not lacked advice to the effect that they were making a mistake in pinning their faith to one type of water tube boiler, and that so long as no one of the many existing types has clearly demonstrated its superiority over the others, a far wiser plan would have been to carry out what is now proposed in the report of the interim committee, viz., comparative tests and trials of different types with a view of determining those best suited to the British naval service.

We have on a former occasion called attention to the difference in policy pursued by our own naval authorities in this matter. While they have quite as definitely adopted the water tube boiler as a general type for all classes of naval construction, no special type has been adopted to the exclusion of others, but rather a policy of trial and experience has been inaugurated exactly along the lines now recommended by the British committee. Such a policy is plainly the only one possible under present conditions, and we are glad to see that the water tube boiler as a general type is still to have a chance in the British service, and having in view the extent of the experience which should soon be available in the United States, Great Britain and other countries where similar policies prevail, it would seem as though we might with confidence look for results which shall go far toward furnishing a definite answer to the question of the type of boiler best suited to naval purposes, and perhaps to the general purposes of the mercantile marine as well.

In the meantime it is only fair to note regarding the Belleville boiler, that M. Belleville has submitted to the Admiralty a statement in which he combats with vigor the conclusions reached by the committee, and urges further consideration of the question at issue. It is very doubtful, however, if anything which can now be said will change the general character of the conclusions reached, or be able to give to the British engineering public renewed confidence in this type of boiler as one suited to the needs and conditions of their naval service.

IN a recent number of MARINE ENGINEERING an account was given of a disastrous explosion of a copper steam pipe. Again, in a recent issue of a British contemporary, we find the details of a somewhat similar case, both explosions resulting in loss of life. This and only too many other like instances brings forcibly to our attention the need of some material for engineering purposes which shall possess the malleability and general working qualities of copper, but with greater tensile strength, and especially without the liability to loss of strength due to so-called "burning" in the operation of brazing or of forming a longitudinal joint. Whether such a material is within the possibilities of modern metallurgical methods is a question for the chemists and metallurgists, but they may be assured that the engineering world is waiting for it. In the meantime much can be done to aid the strength of copper by banding with steel straps or wrapping with steel wire. We do not understand that in either of the cases referred to the pipes were aided in this manner. While copper banded or reinforced with steel does not perhaps make an ideal steam pipe, yet it is certainly much safer than if made of copper alone, and such practice is at least making the best out of the materials at our disposal.

THE CONTEST FOR THE PRIZES.

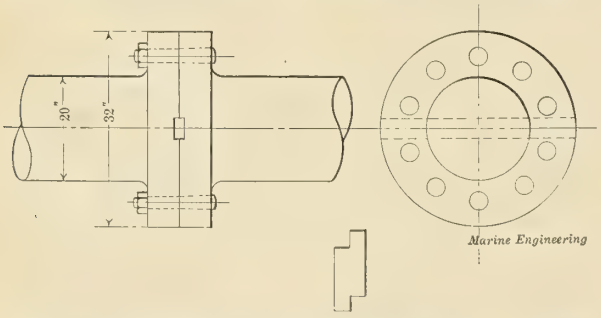
All articles intended for competition for the two prizes of $15 and $10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

Break of Shaft Coupling.

Two years ago one of the single screw express steamers was plowing through calm seas across the Atlantic, when without any warning, a heavy pounding came from the engines and the steam was immediately shut off.

This steamer has triple expansion, five clyinder, three crank engines, indicating about 8,800 H. P., with cylinders 32 1-2 in., 68 in. and 85 in. dia. by 72 in. stroke. The two low pressure cylinders are at the ends and have the high pressures mounted above; the intermediate is mounted over the middle crank. The valves for the forward steeple engine are at the forward side of cylinders, those for the after steeple engine at the after side of cylinders. The valve for the intermediate is forward of that cylinder and worked from eccentrics placed on the crank shaft couplings. Piston valves for the high pressures are operated by the low pressure eccentric tail rods with rocker arms. The intermediate and low pressure cylinders have slide valves.



Each engine is mounted on an *A* frame, the exhaust from each low pressure passing through the back of the frame to its own condenser. Two direct connected air pumps are run from the low pressure cross heads. The sections of shafting are coupled together with ten bolts and a key.

Upon shutting down at the time mentioned, it was discovered that the bolts of the forward coupling had all been sheared off, but that the key had held the sections from slipping, otherwise the engine would have been thrown out of line or further damaged. The engineers immediately set to work drilling out the broken bolts and removing intermediate valve and eccentrics. New bolts and a key were fitted, the eccentric rods chained to housing, and in the thirty-one hours from the time of accident the engines were started under reduced boiler pressure and run as compounds. The voyage was completed at an average rate of about 15 1-2 knots, with only two shut downs of thirty minutes each. A close examination of the fractured bolts did not reveal any flaws in the metal. The ends of the key were bent into a section as shown in the cut.

H. F.

A Peculiar Cause for Thumping in an Engine.

One of the queerest derangements of marine machinery that ever came under my observation occurred on board the U. S. flagship *Philadelphia* while I was attached to that vessel during the Spanish War. We were on a voyage from San Francisco to Acapulco, Mexico, after undergoing a thorough overhauling at the Mare Island Navy Yard.

The first three days out the boilers steamed freely, all parts of the machinery worked to perfection, and the ship was averaging twelve and one-half and thirteen knots under only two boilers with natural draft. In the midwatch of the third night out a slight thumping was noticed in the low-pressure cylinder of the after, or starboard, engine. It was one of those indefinite sounds that might emanate from any one of several sources. Thinking that possibly it might be in the crosshead, no particular attention was paid to it other than watching the crosshead brasses closely to see that they did not heat. The next day the thumping grew worse at intervals, and it was then thought to be in the cylinder. As the pressure in the second receiver was slightly below that of the atmosphere, the expedient of putting about a half pint of cylinder oil in the indicator cocks at each end of the cylinder was resorted to. This seemed to reduce the thumping considerably, the effect of the oil lasting for perhaps a half hour.

In spite of the frequent applications of cylinder oil, however, the thumping continued and gradually grew worse, causing much uneasiness among the engineer's force. Fearing that a follower bolt might have become loosened, the starboard engine was shut down and the manhole plate removed on the cylinder head. A hasty examination with the aid of a portable electric light satisfied us that all follower bolts were secure. The manhole plate was put back, the engine started and the "thump" again resumed business.

It had now become so severe as to jar the whole ship at each stroke of the engine. The noise, coupled with the heat of the tropics, made sleeping a matter of difficulty in the after part of the ship. Even the admiral could not sleep, and when the admiral or commanding officer of a naval vessel has his slumbers disturbed by engine-room noises, there is no peace or joy among the engineer's force. As we were now near Acapulco, the starboard engine was run slowly until we reached that port. The problem then was to find the cause of the terrible thumping, which thus far had baffled all attempts to remedy it, or even to account for it.

The *Philadelphia's* machinery consists of two horizontal, triple-expansion engines, with cylinders 38 in., 58 in. and 86 in. diameter, respectively, by 40 in. stroke. No record could be found in the log books of any previous trouble with the low-pressure cylinder of either engine. After the engine had cooled down sufficiently, the manhole plate was removed from the outboard head, and the cause of the trouble soon found. The inner surface of the head was found to be covered with a hard, black deposit resembling asphalt, which completely filled the clearance space, with the result that the piston had been striking solidly against it at each end of the stroke. Upon

testing a piece of this deposit it was found to be very salty. With this as a clue, it was soon ascertained that the salt came from the evaporator. As with most triple-expansion engines, the auxiliary exhaust line, while the vessel was under way, was always led into the second receivers to still further expand the steam from the auxiliary engines. During the trip the evaporators had been used at intervals to make up the feed water in the boilers, and in this instance the steam from the evaporators was led into the auxiliary exhaust pipe. Through the carelessness of the men in charge of the evaporators, foaming had occurred at intervals, the salt water being thus carried into the auxiliary exhaust pipe and thence into the starboard low-pressure cylinder, where, striking against the cylinder heads, the saline matter had been deposited. The large quantities of cylinder oil introduced through the indicator cocks had mixed with the salt and formed a hard, asphaltum-like substance, completely filling the clearance spaces at each end of the cylinder.

To remove the deposit from the outboard head with sharp scrapers was comparatively easy. The removal from the inboard, or piston rod, end of the cylinder was an entirely different problem, and one that for a day or so completely baffled all hands. There was no manhole in this head, and to remove the piston would necessitate taking down the main air-pump engine, which was located just back of the outboard head. This would have taken at least a week's hard work, and could not be thought of except as a last resort. Eventually, at the suggestion of a bright machinist, a pipe was secured to the inboard indicator connection and extended up as close under the protective deck as possible; the engine was jacked over until the piston was within about two inches of the inboard end of the stroke. Through a large funnel on the end of the pipe, the space thus formed was filled with warm, fresh water, and steam turned on the low-pressure jacket. After boiling for a half hour or so, the inboard drain cock was opened, and a thick, black liquid ran into the bilge. This operation was repeated several times, until clear water ran through, when everyone was satisfied that the salt and oil had been entirely cleaned out.

C. A. McAllister, R. C. S.,
First Assistant Engineer.

Damaged 13 Inch Gun on Kearsarge.—Naval Constructor Capps succeeded in removing the damaged 13 in. gun from the forward turret of the battle ship *Kearsarge* by sliding it through the port in the turret. The greatest outside diameter of the gun is but one quarter of an inch less than the width of the port. The gun was pushed out on a track by hydraulic jacks.

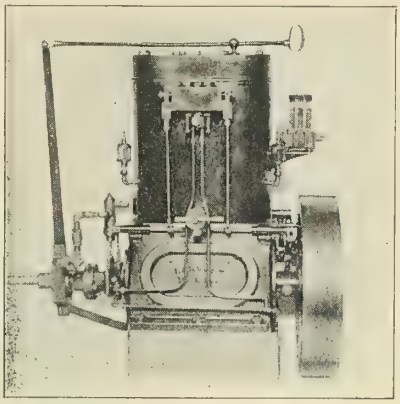
Shaft Broken on S.S. New York.—On April 24 the *New York* came into port with but the starboard engine running. On the 22d a section of the port shaft had broken, and together with the propeller, had dropped out. The steamer will proceed to Cramp's yard, where the machinery will be thoroughly overhauled and the damage repaired. The broken section of shaft is not the one recently fitted to replace the one broken in March. The *Philadelphia*, formerly *Paris*, is expected to be in service by the first of July.

IMPROVED APPARATUS.

Gasoline Engine.

The marine engine illustrated is of the 4-cycle type, receiving an impulse at every second revolution per cylinder. The valve mechanism is direct-acting, thus doing away with noisy cams and levers.

The base is entirely enclosed and contains oil and water in which the cranks rotate, throwing oil to all internal movable parts, making them self-lubricating. The construction of piston is such that the oil thrown by the rotation of cranks is carried the full length of stroke, and distributed along the walls of cylinder thus insuring perfect lubrication. The cranks are of the best forged machinery steel, and ample provision has been made for heavy strains such as are frequent in marine engines. The rods are of machinery steel with hard bronze boxes on the larger sizes, and of hard bronze on the smaller sizes, with ample wearing surface to stand heavy strains without heating. All



SARVENT MARINE GASOLINE ENGINE.

bearings are made of hard bronze and adjustable to take up wear. As the engines work under low compression, the vibration is reduced, permitting the use of smaller and lighter fly wheels. The circulation of water around cylinders, head and exhaust valve, is taken care of by a plunger pump driven direct from shaft, and is discharged directly into exhaust valve, and passes out through exhaust pipe, which is carried away from engine out through stern of boat under water, keeping exhaust pipe cool and destroying noise and odors. The time of ignition is under positive control, and may be changed while engine is in motion. The ignitor is one of the special features, and is of the snap-break type with special hard platinum points and ample provision to prevent oxydation.

The vaporizer is of the latest type and positive in action, using gasoline direct. When the engine stops, the flow of gasoline stops. The speed is controlled by a throttling air valve. Workmanship and materials are the best that can be obtained, and all machines are thoroughly tested and sold under guarantee. This engine is manufactured and placed on the market by the Sarvent Marine Engine Co., of Chicago, Ill.

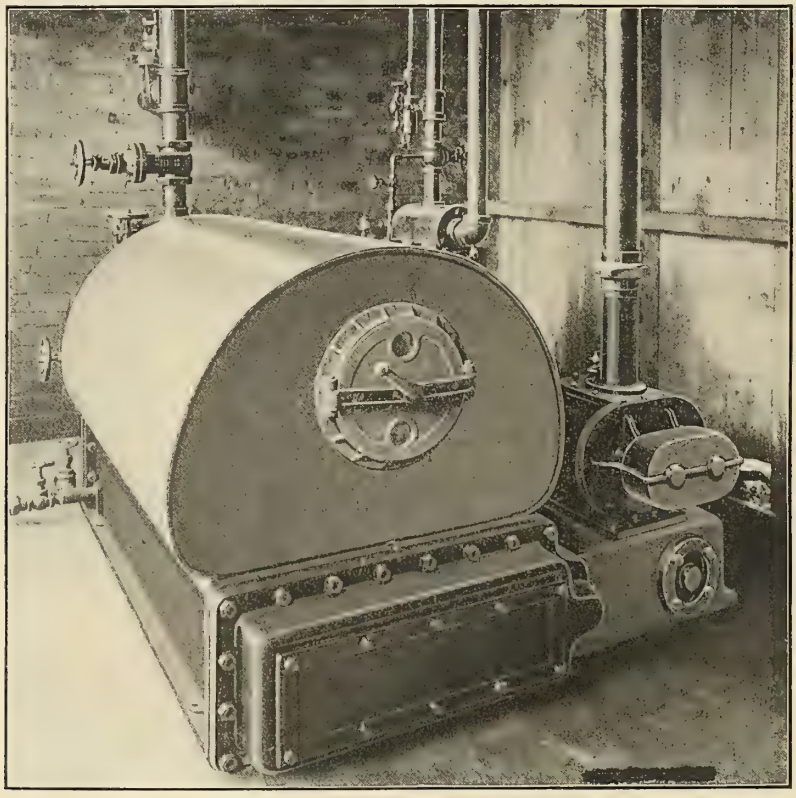
Clayton Fire Extinguisher.

Fires in ships have been so severe and frequent during the past few weeks as to make methods of avoiding this form of disaster more than ordinarily interesting. The death of Lieutenant-Commander Roper on the United States gunboat *Petrel* at Manila, the sinking at her dock of the burning transport *Rawlins,* the return to Hull of the Wilson liner *Ontario* with her cargo in flames, and the destruction at Astrachan of fourteen oil steamers because of the ignition of one, are all too recent to be forgotten. Every year there are two or three hundred fires in ships and about one sixth of these result in complete destruction of the vessels. This showing makes clear the imperative need of some adequate and reliable means for handling fires in the cargo spaces and coal stores of ships.

Water and steam have alike proved unequal to the task of affording security to the mariner. Sometimes, of course, it happens that the stream may be forced to the seat of the fire and if this is done in the early stages, extinction generally results. When, however, the fire develops in a portion of the cargo which is inaccessible, the best that may be hoped for is holding the blaze in check until the shore may be reached and the vessel beached so that wrecking tugs and fire boats may assist her. Of course, this method depends entirely on chance.

Many years ago it was clearly realized that this problem must of necessity be attacked by the methods of chemical engineering, and almost every appliance suggested to the present time has been an application or expansion of the theory of the portable fire extinguisher and the chemical fire engine which have been in use for a generation.

These devices all depend for their effectiveness upon the liberation of carbonic acid gas, and even to the engineering mind this gas seems to appeal as being the most logical and effective. The United States consular reports for April describe some rather elaborate experiments made at Bremen during last March. Since then M. Diobs, a French maritime engineer, has advanced a plan for fighting fires in ships, but both of these schemes employ carbonic acid as the active fire fighting element.



CLAYTON FIRE EXTINGUISHER.

The two great objections, or defects, which render the employment of this gas decidedly difficult, if not altogether impracticable, are the impossibility of developing and distributing the gas in large quantities, and the high point of saturation to which the atmosphere of the chamber containing the fire must be brought. That a briskly burning fire may be extinguished, sixteen to twenty per cent of carbonic acid gas is required, and in certain cargos even this is ineffective. In order to produce the gas it is necessary to employ such great quantities of acid and more or less refractory carbonates that in ship fires the limitations of space and the slow evolution of the gas almost prohibit its use.

There has recently been developed a system for fight-

ing fires in ships by the Clayton Fire Extinguishing & Disinfecting Co., 11 Broadway, New York. The active agent employed is sulphur dioxide gas, which is developed by the burning of crude brimstone. The principal reason for using this gas is the extremely small amount required to extinguish fires; 5 per cent of it will quench the fiercest blaze, and besides this it is 2.2 times as heavy as air, and can be quickly obtained in large quantities by simple methods from a small machine. The illustration gives a fair idea of the form of the apparatus required. Sulphur is burned in the furnace, which is mounted upon the same bed plate with the direct connected pumping outfit which furnishes the air feed for burning the sulphur, and distributes the resulting gases throughout the ship. The furnace has been so designed that every particle of oxygen entering it is combined with the sulphur, with the result that sulphur gas and nitrogen alone are pumped into the hold. Both of these gases are enemies to fire, and unlike steam and water they can never by the fiercest fire be decomposed to furnish oxygen for further combustion and thus defeat the very purpose for which they were injected.

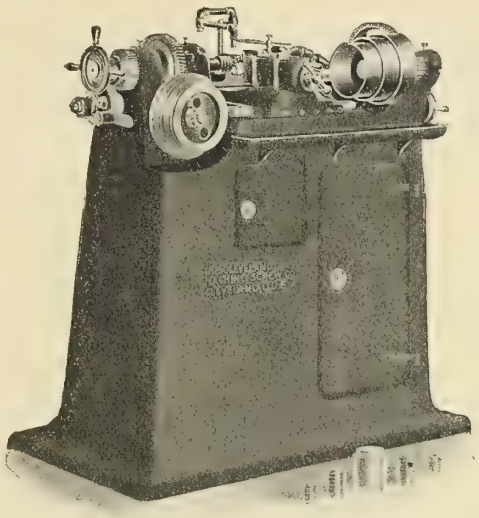
Many experiments have been made in New York to demonstrate the effectiveness of the apparatus and of this system; these have been not only in the direction of showing positively the powers of the gas by means of extinguishing fires which have been lighted and allowed to burn freely, but they have also been designed to show the power of sulphur dioxide to prevent combustion. In order to demonstrate this latter quality a chamber containing about fifty-five hundred cubic feet in which combustibles like naphtha, cotton and hay have been placed, is filled with gas. Incandescent plates of iron are lowered through the roof of the building into these, the only results being that the naphtha boils and the cotton and hay are merely charred, with hardly more than a curl of smoke. Even if the irons are allowed to remain there until they are cool no further action results.

The greatest step in advance, however, that has been made in the development of this system has been the solution of the problem of putting out cotton fires in ships. There is no more baffling or stubborn fire than tightly packed cotton, because neither water nor steam suffices to extinguish it. A vessel of a well known steamship line with burning cotton in her hold was purposely sunk at her pier; when she was raised two weeks later the flames burst out anew. Despite the tenacity of such fires it is claimed that sulphur dioxide will conquer them, and that this treatment will further prevent the re-ignition of the hot cotton on exposure to the air. Of course, the great advantage of any method of gaseous treatment is that when the fire stops the loss ceases. Insurance men declare with good reason that the loss from water, even in a serious fire, exceeds the loss due to burning; and in a small fire the water loss outweighs many times that due to the fire itself. The advantage of having the contents of a hold damaged by fire alone, if fires there must be, is too evident to require elaboration. Sulphur dioxide, while an active fire fighter, is at the same time entirely safe to use, as it will not injure any commodities save, perhaps, those containing moisture in large quantities.

Worm Milling Machine.

The milling machine herewith illustrated is intended to produce worm gearing at greatly reduced cost, and at the same time accurate in pitch, depth of cut and finish. The advantages of the milling machine as a means of removing material are now too well understood to require especial note. In this machine a new principle is employed by which worms may be produced by milling, and of any pitch, single, double, triple or quadruple threads (either right or left hand), and it is claimed at a speed from five to eight times faster than can be done with a lathe, and with much greater accuracy.

The cutter holder is mounted on a slide which travels forward and back on ways, by means of a coarse pitch screw. The cutter and worm blank are always held in proper relation by the screw driven through gearing



MILLING MACHINE FOR WORM GEARING.

from the main spindle which carries the blank, making it impossible to lose the thread should the cutter be drawn out of the work.

The cutter resembles an ordinary rack cutter, one cutter being required for every different pitch of worm thread. However, the same cutter is often correct for different threads; for instance, the cutter for 1-4 in. thread is correct for 1-2 in. thread double, 1 in. thread quadruple, etc.

The teeth of the cutter can be ground on their faces without changing the form, insuring perfectly shaped threads and spaces and exact duplication for all worms of the same kind.

The machine is driven by two belts from the countershaft, one driving the cutter, the other the feed.

The cutter spindle is back geared, and ball joints are provided so that the cutter may be set to the angle of worm thread. In cutting a worm, the cutter is set to the proper depth for cut by a micrometer adjustment, and to the angle of the thread to be cut by means of a segment of a ring graduated in degrees. The cutter may be adjusted in or out without altering the angle.

The cutter and worm blank both rotate at relative

speeds to cut any desired length of thread; a continuous stream of oil floods the cutting edge, constantly washing all chips into the bed inside of the machine.

In cutting a single thread worm, the cutter advances through the blank once (or, if desired, two cuts may be taken, one roughing and one finishing), completing the worm, when the machine stops automatically.

When cutting a double thread worm, after the cutter is through the first thread, the machine stops automatically, and the cutter is drawn out of the thread. It is then but the work of a few seconds to adjust the machine for the second thread. The movements are identical for triple and quadruple threads, etc.

The machine is so arranged that it will cut any even or uneven number of threads per inch without compounding the change gear in any case.

All end thrusts are taken on ball bearings, and all running bearings are bushed.

The machine has a cabinet base; floor space, 2 ft. 2 in. by 4 ft.

It does not require a specially skilled mechanic to operate these machines, and one man can attend to four or five at a time.

This machine has been developed and placed on the market by the Cleveland Machine Screw Co., of Cleveland, Ohio.

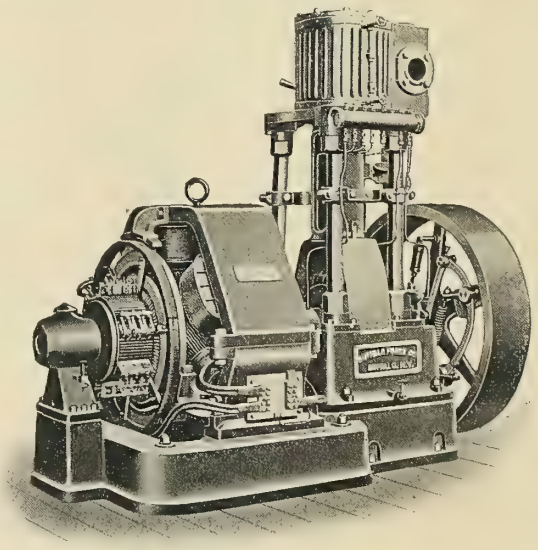
Marine Generating Set.

The generating set shown herewith consists of a Standard marine type simple engine built by the Buffalo Forge Company, of Buffalo, N. Y., connected to a multipolar Elwell-Parker Company's generator. The following points relate particularly to the engine.

The generator and engine proper are both carried upon a cast iron extended sub base, designed especially to carry the generator and outboard bearing. The engine base bolted to the sub base is cored out so as to combine strength with lightness. It carries the four upright frame rods and in addition provides bearings for the crank shaft. The four frame rods mentioned are of machine steel screwed at either end into small cast iron pads and locked with a jam nut, as shown. The pads or plates themselves are bolted at the bottom to the base and at the top to the head or cylinder base plate, thus giving a very solid construction. These frame rods combine maximum lightness and rigidity and also afford ready accessibility of parts. In fact, throughout the whole machine an extremely high factor of safety has been preserved.

The cylinder, steam chest and bottom head plate are cast in one piece, the latter carrying the stuffing boxes and affording means for securing the rods. The cylinder is accurately bored and counter bored and is also provided with indicator connections, as shown. Two circular cages or bushings drawn into place in the steam chest form the seats and ports for the piston valve.

The piston is cast in one piece and fitted with the usual cast iron snap ring. It is cored very thin to reduce weight, but is thoroughly braced and sufficiently strong for any reasonable strain. The piston rod is of the best machine steel tapered, ground to fit and bolted to the head by a countersunk nut. At the lower end the piston rod screws into a crosshead of the marine type. This latter is provided with a single shoe which works upon a guide plate bolted to the frame, as shown in the cut. The engine is designed to run so that the guide pressure will always be taken up by this plate, but two small additional guides are bolted to the main guide plate in such a manner that the crosshead shoe will be inclosed on two sides. The connecting rod at the wrist pin is of the usual marine forked pattern, but at its lower end resembles closely a locomotive end with strap and babbitted boxes. A wedge and screw adjustment is provided for taking up any wear. The crank shaft is a single forging resting in the base bearings, as already mentioned, while to the cranks cast iron counterweight disks are secured in such a manner as to minimize the shaking forces. The cut shows a coupling shrunk and keyed on one end of the shaft and on the other end the fly wheel and governor. This governor, by its swinging eccentric controlling the



DIRECT CONNECTED GENERATING SET.

valve travel, insures constant lead of the valve for all points of cut off, and the provision on all the governor pins of oil cups or grease pots further insures that sensitiveness, ease of running and minimum need of attention so essential for the sustained high speeds of marine service. The eccentric rod at its upper end takes hold of a horizontal extension of the valve rod, which by means of a guide bearing carried from the base of the steam chest is constrained to move in a straight line. A construction much superior to the old rocker arm valve rod motion is thus provided.

In order to insure continuous high speeds the greatest care throughout the design must be taken to prevent the likelihood of heating of any parts. For this reason, also, the lubrication must be superabundant. In the type of engines illustrated a multiple oil system is fitted and special care has been given to all features affecting the lubrication. From a large glass ended oil receiver situated on the level of the cylinder base small pipes lead through sight feed devices to each journal or rubbing surface, insuring in this manner that the oil shall be applied to the proper place in the proper quantity.

The Topophone.

It is a well known fact that it is difficult to properly locate the direction of sound in a fog. It is not unusual for trained observers to differ widely among themselves in locating a sound signal, making it impossible for the master of a vessel to decide which one is correct.

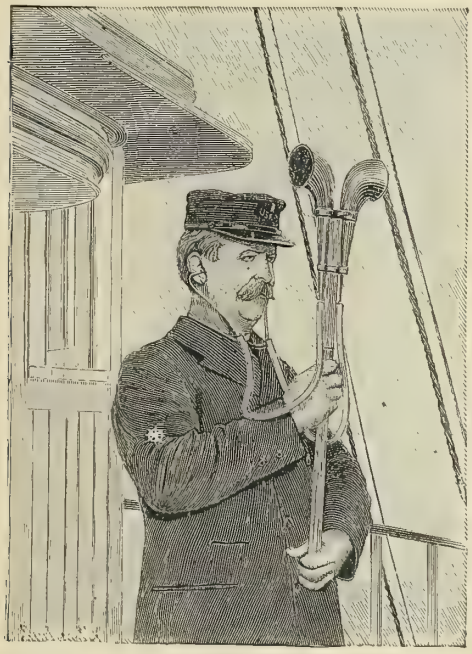
The gravest accidents have occurred from this, and records show the loss of many a vessel simply because the master was in error as to the direction of the warning signal.

The topophone was invented by Lieut.-Col. D. P. Heap, Corps of Engineer, U. S. A., in order to place at the service of masters of vessels a simple, inexpensive instrument to assist in determining the exact direction of any sound, and thus to save life and property.

The following claims are made for this instrument:

1. It will locate the direction of a sound within one point of the compass.

2. It will enable an observer to hear sounds at greater distances with the instrument than without it.



INSTRUMENT FOR LOCATING THE DIRECTION OF SOUND.

The topophone consists of two acoustic receivers, or hearing trumpets, mounted on a vertical shaft and facing in opposite directions.

To the lower end of each trumpet is attached a rubber tube leading to metal hearing tubes with hard rubber earpieces. In use, these are placed in the ears, being careful to place the one connected with the right-hand trumpet in the right ear and the other in the left.

The vertical shaft is then held in front of the body so that the trumpets will be above the head.

If the sound which it is desired to locate should happen to be directly in front of the observer, the sound would be heard equally well in both ears.

But should it proceed from either side, the right hand, for example, the sound would be heard louder in the right ear; and if the observer then turns to the right, he will arrive at a position in which the sound will be heard louder in the left ear, showing that he has passed the direction of the sound.

Then, by oscillating the instrument through a small angle so as to hear the sound alternately in each ear, he will have placed the instrument so that the pointer will be in the direction of the sound and the trumpet will face at right angles to it.

As the acoustic receivers make very efficient hearing trumpets, sounds can be heard which are inaudible to the unassisted ear, and consequently the direction of a fog signal can be determined at longer distances by their use.

The general agents for this instrument are the J. B. Colt Co., of New York city.

S.S. G. A. Flagg.—The steamer *G. A. Flagg*, built for D. R. Hanna, of Cleveland, Ohio, was recently launched. The principal dimensions of the *Flagg* are: Length, 366 ft. over all; beam, 42 ft.; and depth, 26 1-2 ft. The boat will be used in the copper trade on Lake Erie.

The Dry Dock just completed in the shipyard of the Tietjen & Lang Dry Dock Co., Hoboken, N. J., so fully described and illustrated in the May issue of Marine Engineering, was designed and built under the supervision of Mr. W. K. Donnelly, of the firm of Faber du Faur & Donnelly, New York. To make room for this large dry dock it has been necessary for the Tietjen & Lang Company to change the location of its plant from the river front near 14th street, Hoboken, to the back of Weehawken Cove, where the company has a frontage of 900 feet on Park avenue. When the plans now being carried out are completed the plant will cover about twenty acres of land and water property and will have a complete equipment of metal and wood working tools.

Yacht Races.—The four yachts from which are to be selected a challenger and defender of the American Cup, are in the water. The design of *Shamrock II*, prepared by G. L. Watson, is the result of an exhaustive series of model experiments carried out in the experimental tank of Denny Brothers, Dunbarton. Accurate models of former challengers and modifications of each were tested one against the other so that we can look upon *Shamrock II* as the highest type of the British yacht. However, in the few trial spins between the two *Shamrocks*, which have been held up to date, it is impossible to state which is the speedier boat, and the mishap to *Shamrock II* whereby she lost her mast and sails will delay the decisive tests for at least two months. The *Constitution*, designed and built by the Herreshoffs, is undergoing preliminary spins off Bristol, and the *Independence* was launched at Boston on May 19. B. B. Crowninshield, who designed the latter yacht, has made several innovations from the plans of former defenders and has given his boat greater length, longer and straighter diagonals and a larger rig than the Bristol boats. Owing to these great races, exceptional interest is being taken in yachting in all directions, and the many yacht works are crowded with orders.

GROUNDED AND SHORT-CIRCUITED FIELDS—HOW TO FIND AND REPAIR.

BY WM. BAXTER, JR.

If an electrical machine, whether generator or motor, is grounded it will run perfectly unless grounded at two points, or unless there is a ground at some point in the circuit outside of the machine. It is not wise, however, to allow a machine to remain grounded if the defect can be located and repaired, because there is always a liability of a second ground being developed at some other point; and when this occurs, there is sure to be trouble. It is possible for two grounds to exist either in a machine or in some other part of the circuit without doing any noticeable damage, but such conditions are not very often met with. For two grounds to be harmless they must be very close together, measuring distance not by the number of feet of circuit between the points, but by the number of ohms of resistance. To illustrate this point, suppose that in a circuit in which the voltage is 100, there are two grounds and that the resistance between them, measured along the circuit, and not across it, is the one hundredth part of an ohm; then, if the current flowing in the line is 100 amperes, the difference of potential between these two points will be one volt; and this will not send a very strong current through the ground connection unless the resistance by that path is very low; lower, in fact, than it is likely to be in practice. If one defect is on one side of the circuit, and the other one is on the opposite side, then the resistance between them will be the resistance of the ground circuit, and in that case, as the current would be forced through this circuit by the whole voltage of the generator, 100 volts, it would be very strong; in fact, far more than the machine could furnish. If the resistance were as low as assumed in the foregoing, the strength of current through the ground circuit would be 10,000 amperes, providing the generator could furnish it. From the foreging it will be seen that it is only in cases where the two grounds are on the same side of the circuit, and the resistance of the portion of circuit between them is very low, that they will not do any noticeable damage. A ground in a circuit or in a machine connected in the circuit can be detected in several very simple ways, perhaps the most simple being to connect one end of a wire with any part of the circuit, and the other end with the ground, which in the case of a ship made of iron or steel would be any part of the hull. This method of testing for grounds, however, is not to be recommended, as it is very much like trying to ascertain whether bombshells contain powder by inserting a red hot poker in the fuse hole. In testing for a ground we should take precautions that will prevent the passage of a strong current through the defective point, for this current may cause a burnout.

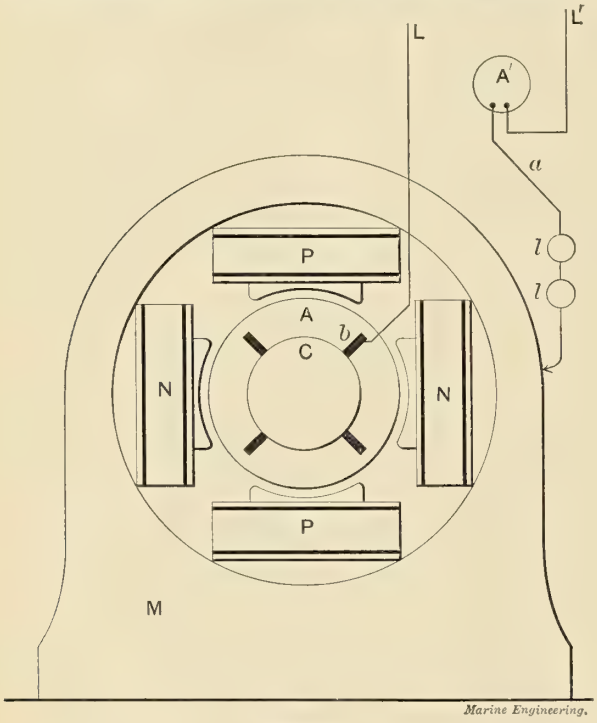


FIG. 12.

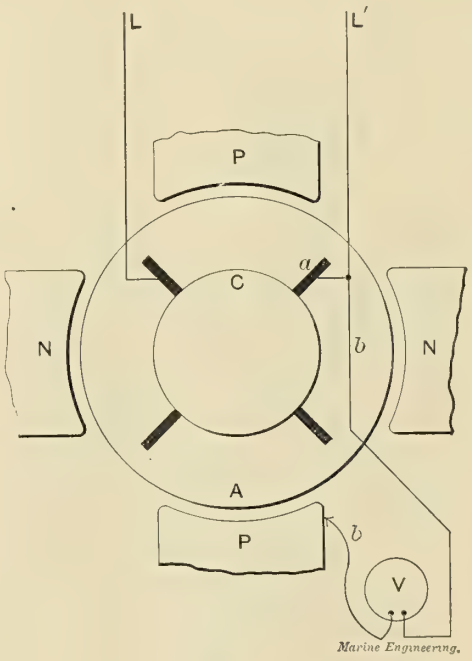


FIG. 13.

A ground can be detected either by the use of an ammeter or a volmeter. If the former instrument is used, a high resistance should be placed in series with it, so as to prevent a strong current from passing. The best thing to use for a resistance is a number of incandescent lamps. The ammeter for this purpose must be of low range, so that the needle will move a noticeable amount with a weak current. An instrument that reads up to 100 amperes will not give an indication with a current smaller than one-half of an ampere unless it is held in such a way as to be free from vibration. If an instrument cannot be obtained that reads from five or ten amperes down, the ammeter test is no better than one made with an incandescent lamp alone.

To test a motor for grounds with an ammeter the

connections are made as in Fig. 12, with one of the line wires connected with the instrument and the other with one of the commutator brushes. This will show whether there is a ground in the armature or commutator. If these parts are found clear, the connection is transferred to the field coils. In both tests the armature and field connections are broken so that the current cannot pass from one to the other.

Although a test can be made with an ammeter, by far the most desirable instrument is a voltmeter; for with such an instrument only a very small current can pass through the ground connection, and it is not necessary to insert resistance in series with the instrument. For testing with a voltmeter, the connections for a motor are made as in Fig. 13, which represents the commutator *C*, armature *A* and poles *P P N N*. The voltmeter is shown at *V*, one terminal being connected with one of the commutator brushes and the other with one of the pole pieces. As in the previous illustration, when the armature has been tested, the line wires are transferred to the field coils.

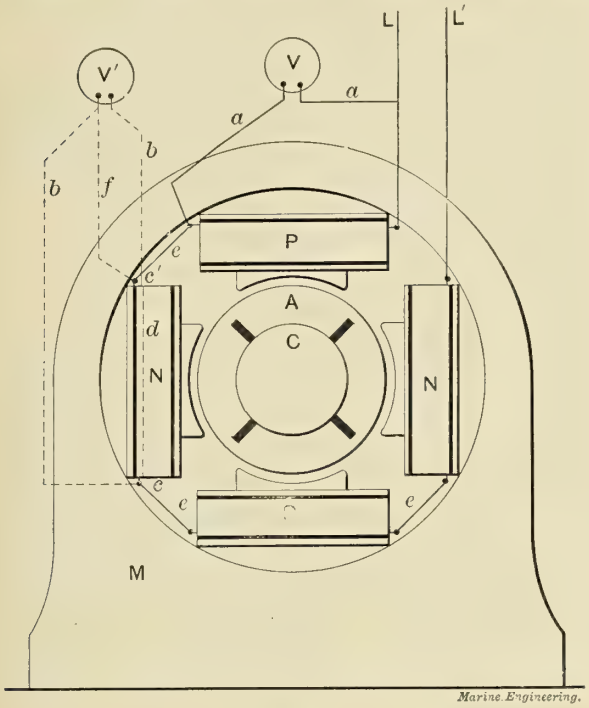


FIG. 14.

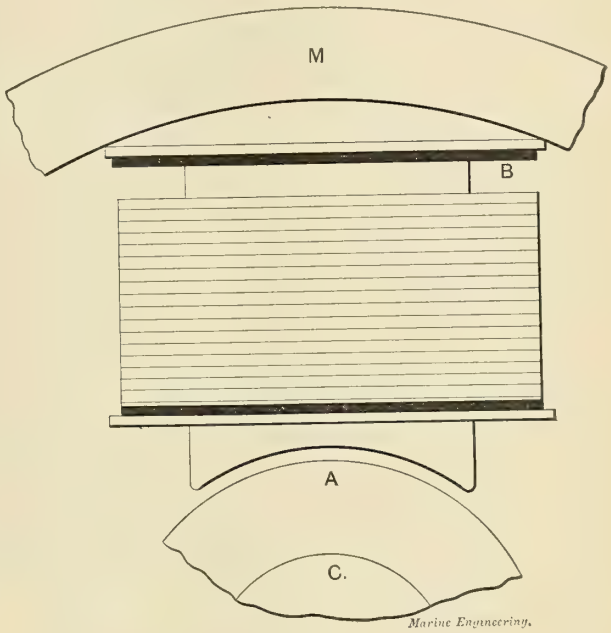


FIG. 15.

A test made as illustrated in both the figures will only show whether there is a leak in the insulation between the armature or field wire and the frame of the machine; but unless the machine is insulated from the ground such a leak will produce a ground connection, and if the machine is insulated from the ground, then it cannot become grounded by defects in the insulation of either the armature or the field coils. There is greater liability of the insulation between the coils and the frame of the machine being impaired than of an actual ground, and such a defect is just as likely to lead to disastrous result as the latter, and hence it is just as important to guard against them.

A single leak in the coils of a motor or generator will not produce any effect upon the running of the machine, providing the frame is well insulated from the ground. If there is a defect in the armature insulation and a second one breaks out in the field coils, the fact will be discovered at once by severe sparking at the brushes; that is, providing the current that escapes through the defective points does not produce a burn out in the armature or the defective field coil before the disordered condition of the machine is discovered. Generally a case of this kind proves fatal to the machine in short order.

If there is a defect in one of the field coils and another one is formed, the machine may continue to run without giving any indication of what has happened except by a change in the velocity if a motor, or of voltage if a generator; and also by increased sparking at the brushes. The second defect may be in the same coil or in one of the other coils. If it is located in one of the other coils the action of the machine may be very seriously interfered with; but if in the same coil it will only cause a slight change in the speed or voltage and cause the brushes to spark somewhat more.

The manner in which field coil short circuits can be found is illustrated in Fig. 14. When the ends of the field coils are connected with the line wires *L L'* the whole voltage of the circuit will be impressed upon the field, and a voltmeter connected to the terminals of one of the coils, as at the top coil by means of wires *a a*, should indicate a difference of potential equal to the full line voltage divided by the number of coils. Thus, suppose that in the diagram the line e. m. f. is 100 volts, then there being four field coils, the voltmeter *V* should indicate 25 volts and the same reading should be obtained from all the coils if they are perfect. If the instrument *V* reads 32 volts, for example, we know at once that some of the field wire is short circuited. Suppose we now connect the voltmeter to the next field coil, as shown by *V'*, which is connected with the points *c c'* by the wires *b b*. If in

this position the instrument indicates zero, or a very low voltage, we know that this coil is short circuited, either in part or in whole. If the reading is zero the whole coil is short circuited, for such a reading could not be obtained otherwise, unless we connected points *c c'* by a wire *d* or connected both terminals of the instrument with point *c'*, as indicated by lines *b* and *f*.

By means of the foregoing test the coil, or coils, in which the defects are located can be found and then we have to examine them so as to find the defective points. This inspection sometimes reveals the defects in a simple manner and sometimes it does not. If the contacts at the short circuit points are perfect the resistance will be so low that the heat developed by the

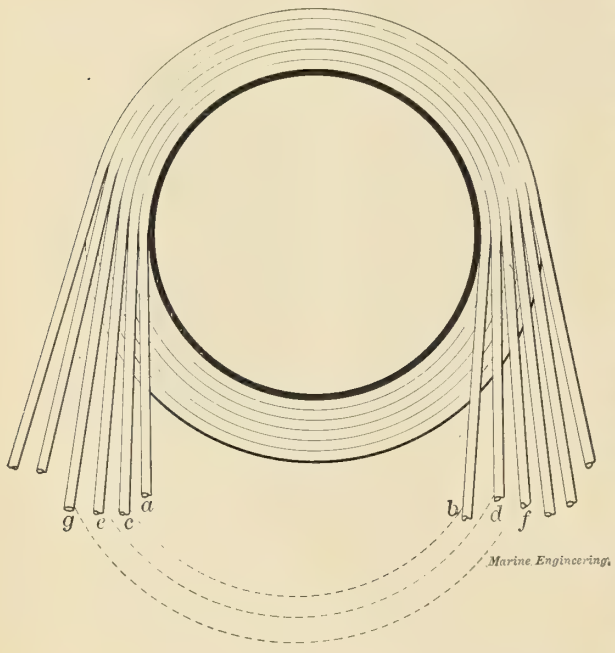


FIG. 16.

current passing through them will not be sufficient to increase the temperature to any noticeable extent, and in such cases it is practically impossible to find the defects except by judging from external appearance, where they are the most likely to be; and in so judging we may hit wide of the mark or not. As a rule, however, the contact at the short circuit points will not be very perfect and on that account a sufficient amount of heat will be generated to at least cause the shellac to smell, so that by tracing the odor the defect can be located. In many cases the heat generated is sufficient to burn the insulation and even fuse the wire in its vicinity, and thus cause a small explosion which bursts through to the surface of the coil.

In any case where the short circuit points can be definitely located the wire around them can be removed, as is indicated in Fig. 15, and then the ends of the sound portion of the coil can be reconnected so as to render the machine serviceable until port is reached. To do this work, when the defective wire has been removed and the coil is well cleaned off, the ends of the several layers are spread out so that we may see where they come from, as is shown in Fig. 16. We then take a battery and a detector galvanometer, or a magneto testing bell, and connect one end with wire *a*. We then connect the other end with the several wires on the right side and thus find the end *b* of the same layer. This end we connect with *c* and then again hunt for the other end of *c* among the right side wires. When we find this end which is *d*, we connect it with *e* and then by the same process as before find end *f*, which we connect with *g*. In this way we proceed until all the ends are connected, when the machine will be ready to run again. If only a small portion of the coil has been removed, the machine will work in a satisfactory manner; but if a considerable portion is taken off, the brushes may spark badly. In such an event we can wind wire by hand in the vacant space or even on top of the balance of the coil until the sparking is reduced to a permissible amount. Even if the wire is not well wound around the magnet it will not affect its action. It will simply make it look patched up, but appearances count for little in such cases.

REPAIRS ON S.S. CAMPERDOWN.

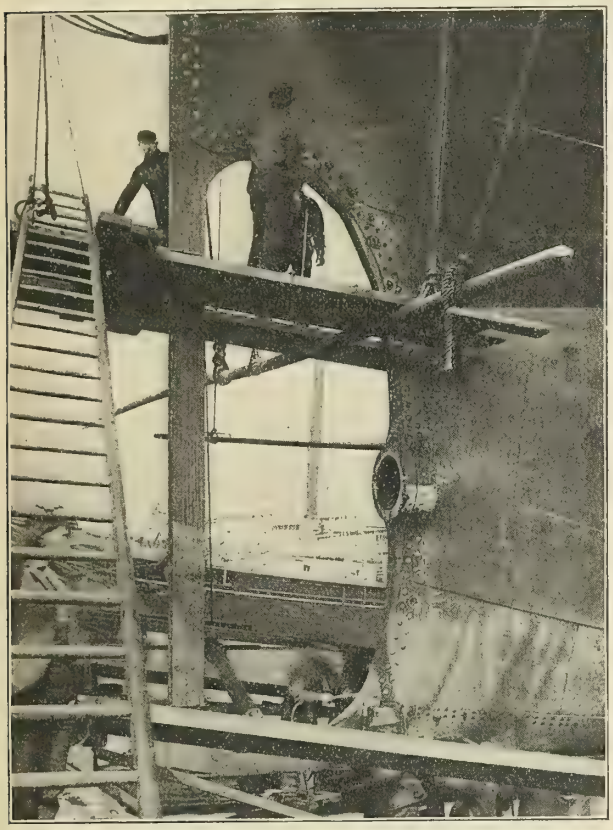
An interesting repair job has recently been completed on the British freight steamer *Camperdown*, which went ashore on the North Carolina coast the middle of March. The steamer was on her way to New York from Cuba with a cargo of sugar. She is owned by Glen & Co., of Glasgow and was built in 1898 by R. Napier & Sons, Ltd., of the same port. Her dimensions are: Length between perpendiculars, 310 ft.; breadth, 42 ft. 2 in.; depth, 20 ft. 4 in, with tonnage of 2,554 gross tons. The machinery consists of one triple expansion engine with cylinders 23 in., 38 in., 62 in. diameter, respectively, and 39 in. stroke. Steam is supplied by two single ended Scotch boilers. There is a complete cellular water bottom, and it is this which saved the ship from total loss.

Three days after grounding she got off without assistance, and when upon examination it was shown that but little water was leaking, the captain decided to proceed to New York. The crew mutinied at this, wishing to go to the nearest port, but for their only satisfaction they were placed in chains and turned over to the police upon arriving at New York, which port the ship reached without further incident.

The cargo, which proved to be uninjured, was then discharged, and the steamer placed on the James Shewan Dry Dock, New York City. The bottom plates were found to be badly bent, and the cast steel stern post cracked across the large section where the propeller post and shoe are joined. This was replaced by a wrought iron stern post weighing 18,000 lb., forged by the Patterson Steel & Iron Forge Co. All the bent plates were removed and straightened, and the entire bottom from bilge to bilge re-riveted. The tank top was not injured, but eighteen floor plates had buckled in the sections near the lightening holes. These were straightened by heating and the use of strong backs. The accompanying view shows the new post partially riveted, the place of fracture on the former one being hidden by the workman's head.

In all the work of cutting out rivets and drilling new holes, pneumatic tools were used. The work was

rushed day and night, and thirty-three days after the *Camperdown* went on the dock she was floated off with hull repairs completed. She was then taken by the contractors, the Columbia Engineering Works, to Erie Basin, and an extensive overhauling of boilers, engines and shafting was made. The cast steel engine bed under the low pressure cylinder was cracked. This was repaired by bolting on a one-inch



RIVETING NEW STERN POST ON S.S. CAMPERDOWN.

plate cut to fit the entire face of the casting. Some of the webs of the crank shaft had worked loose and were replaced. The other lengths of shafting were set in the lathe and turned up where necessary. All auxiliary machinery was also overhauled, and within two months from the date of accident the *Camperdown* was again under her own steam.

S.S. North Star.—The steamship *North Star,* built for the Maine Steamship Co., Portland, Me., was launched from the Roach Shipyard, Chester, Pa., recently. The principal dimensions are: Length over all, 325 ft.; beam, 46 ft.; depth of hold, 19 ft. 10 in. She will be fitted with a triple expansion engine with cylinders 28 in., 48 in. and 75 in. in dia., and 54 in. stroke. Steam will be supplied by six Scotch boilers of 13 ft. 6 in. dia., and 12 ft. 6 in. long. She is equipped with every modern convenience for comfort and safety. There will be accommodations for about 108 passengers. She is expected to have a speed of 18 knots.

TECHNICAL PUBLICATIONS.

Chemistry of Materials of Engineering. By A. H. Sexton, F.C.S. First Edition. The Technical Publishing Co., Ltd., Manchester, England. Size, 5 by 7 1-2. Pages 331.

This book has been prepared to meet the needs of engineering students, and is the result of a course of lectures on the materials of engineering which for some years the author has given to the engineering students in the Glasgow and West of Scotland Technical College.

The book is divided into twenty-five chapters, of which the first sixteen treat of metals and alloys, while the remaining chapters treat respectively of the following: Wood, Stone, Clay and Clayware, Mortars and Cements, Fuels, Water, Lubricants, Paints and Varnishes, Minor Materials.

In treating of the metals the author deals with their sources in nature, the processes for their reduction and refinement, especially from the chemical standpoint, likewise their physical properties and the influences upon them due to various impurities or special ingredients which it may be impracticable to completely remove. The treatment of iron and steel is especially full and contains, in addition to the line of topics above mentioned, chapters on hardening and tempering, on working in general, on corrosion and protection from corrosive influences, and on the microscopic structure of these metals.

The three chapters on fuel, water and lubricants are also of especial interest and value to the engineer. In the first the perfect combustion and the calorific power of the various constituents of fuels are considered. This is then followed by a discussion of the combustion and calorific power of the various actual fuels, and the influences due to the variation in the proportions of the constituents and in the amount of ash. The various solid fuels, as found in nature and as produced artificially are then considered from the various special points in which they interest the engineer. This is followed by a like discussion of liquid fuels and of gaseous fuels, either natural or artificial, as produced by the various processes known in the arts.

In the chapter on water the various natural sources are discussed together with the impurities usually met with, especially as they bear on its use in a steam boiler. Boiler scale, its formation and prevention are considered at length, as well as the simpler methods available for water analysis.

In the chapter on lubricants, the author discusses the laws of friction, the characteristics of a good lubricant, and its various physical properties as modified by the especial purpose for which it is to be used.

The various commercial lubricants are then passed in review and note made of their special points, and of the services for which they are best suited.

The subject of paints and varnishes treated in Chapter XXIV is also one of large importance to the engineer. Note is here made of the chemical foundation of the various paints and of the conditions necessary in order that a paint may possess the properties required for any given service.

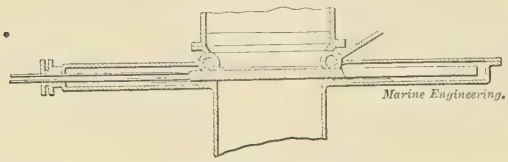
In the chapter on minor materials the author discusses polishing materials, glue and like substances,

hemp, flax, jute, paper, leather, india rubber, gutta percha, etc., from the standpoint of the properties which may render them of use to the engineer.

As a whole, the subject matter of the book has been selected with intelligent judgment, having in view the needs of the engineering student. The author's style is clear, and the book is well arranged for purposes of quick reference to specific points. A comprehensive index, however, would have added greatly to the value of the book for reference purposes, and it may be hoped that in a later edition this lack may be supplied. Illustrations are introduced throughout the book where they may be of aid in explaining the subject matter of the text. The author may properly be congratulated on having produced a book which should fill a distinct need, and it may be cordially recommended to all who may be interested in having at hand a convenient text book relating to the chemical and physical characteristics and properties of the various materials used for engineering purposes.

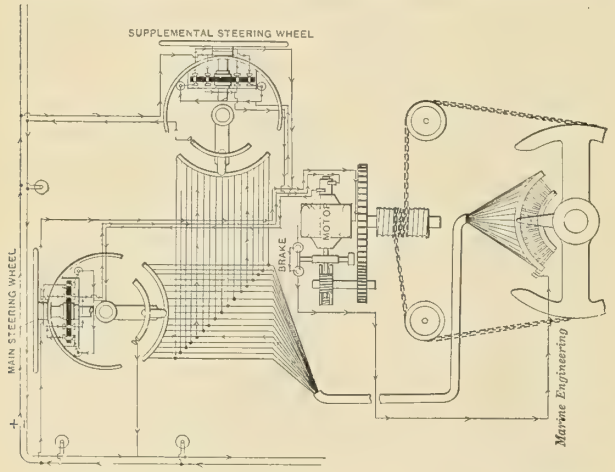
SELECTED MARINE PATENTS.

672,641. DEVICE FOR CLOSING DISCHARGE-ORIFICES OF VESSELS. LUDWIG HIRT, GREVENBROICH, GERMANY.



CLAIMS.—In a casing connected to the wall of the orifice, a closure-slide provided with an opening corresponding with opening of orifice, and operated by a rod. Inflatable packing is arranged in casing to form air tight joint between slide and casing when orifice is closed.

672,851. ELECTRICAL TRANSMISSION OF MOTION FOR STEERING SHIPS. HARRY A. SPILLER, BOSTON, MASS.

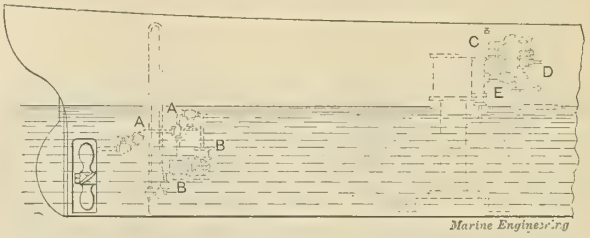


CLAIMS.—The combination of one or more steering wheels with an electric motor and circuit-interrupting switch for operating the rudder. The rudder will respond at once to any movement of steering wheel and will stop upon reaching corresponding position through action of a brake.

672,971. ROTARY PUMP. GEORGE WESTINGHOUSE, PITTSBURG, PA.

CLAIMS.—A pump comprising a cylinder in which is mounted eccentrically a rotable drum.

673,013. WAVE GOVERNOR FOR MARINE ENGINE. W. A. M. BORRESEN, PHILADELPHIA, PA.



CLAIMS.—A throttle governor is operated indirectly by the relative rising and falling of the water at the stern of the steamer, thereby compressing or relieving air in the passages *A A* and operating the pistons *B B*, which in turn break or make an electric circuit passing through the magnet *C*. This magnet controls the steam piston *D* which operates the throttle valve *E*.

673,264. THRUST BEARING. JOHN HOLT, ASTON, ENGLAND.

CLAIMS.—In the thrust bearing the members have coned thrust transmitting and receiving surfaces, with coned rollers interposed, and a keeper and pressure ring which rotates freely and engages the rollers.

673,480. APPARATUS FOR SIGNALING BY NIGHT. LEOPOLD SELLNER, VIENNA, AUSTRIA.

CLAIMS.—An electric light signaling apparatus comprising two or more lanterns of different colored lights and a device for making and breaking the circuits to each light, such device to be operated and intelligible signals sent by passing through a perforated ribbon.

673,777. MECHANISM FOR RECORDING THE MOVEMENTS OF STEERING GEAR. JOHN E. LIARDET, LONDON, ENG.

CLAIMS.—A mechanism attached to the steering gear of a vessel to record upon a paper tape the time of, and extent and direction of each and every movement of the steering gear.

673,967. FLUE SCRAPER. LA FAYETTE ROLLINS, ALBANY, N. Y.

CLAIMS.—A boiler flue cleaner with conical head, and scrapers revolved by a central rod.

674,002. DEVICE FOR UTILIZING THE POWER OF WAVES. MAX GEHRE, RATH, GERMANY.

674,008. LUBRICATING DEVICE. MICHAEL KRAHER, SAN FRANCISCO, CAL.

674,021. ASH EJECTOR. HORACE SEE, NEW YORK, N. Y.

CLAIMS.—A combination with a vessel, of a hopper with hermetically closing lid, a discharge pipe leading overboard, means for establishing a water jet through said discharge pipe, and an air chamber through which the water jet passes before entering the discharge pipe.

674,180-85. STEAM INJECTORS. FRANCIS STECKER, NEW YORK, N. Y.

674,126-27. LUBRICATORS. HENRY W. SIMMS, BAY CITY, MICH.

674,325. ROD PACKING. THOMAS WALKER, PHILADELPHIA, PA.